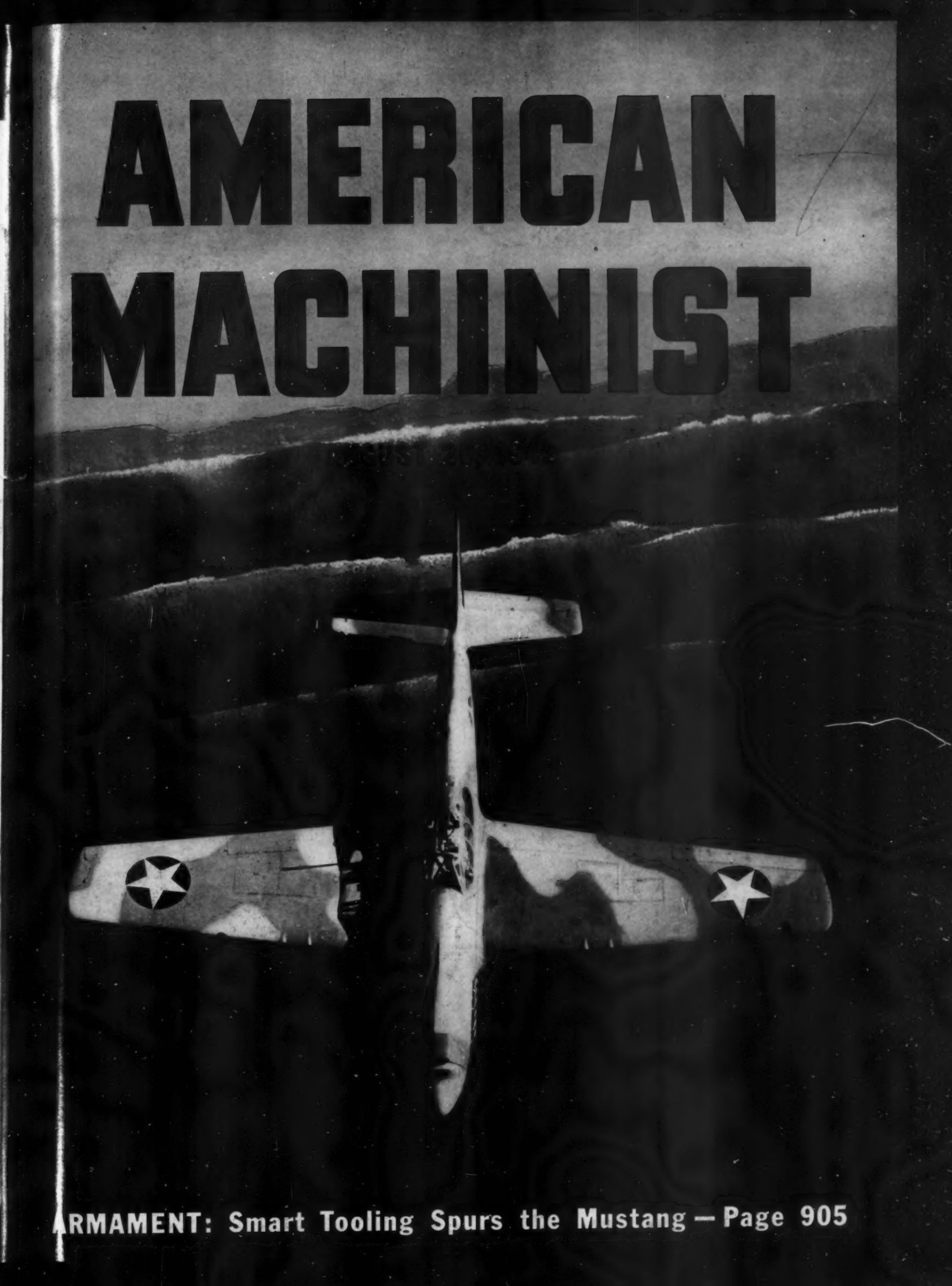
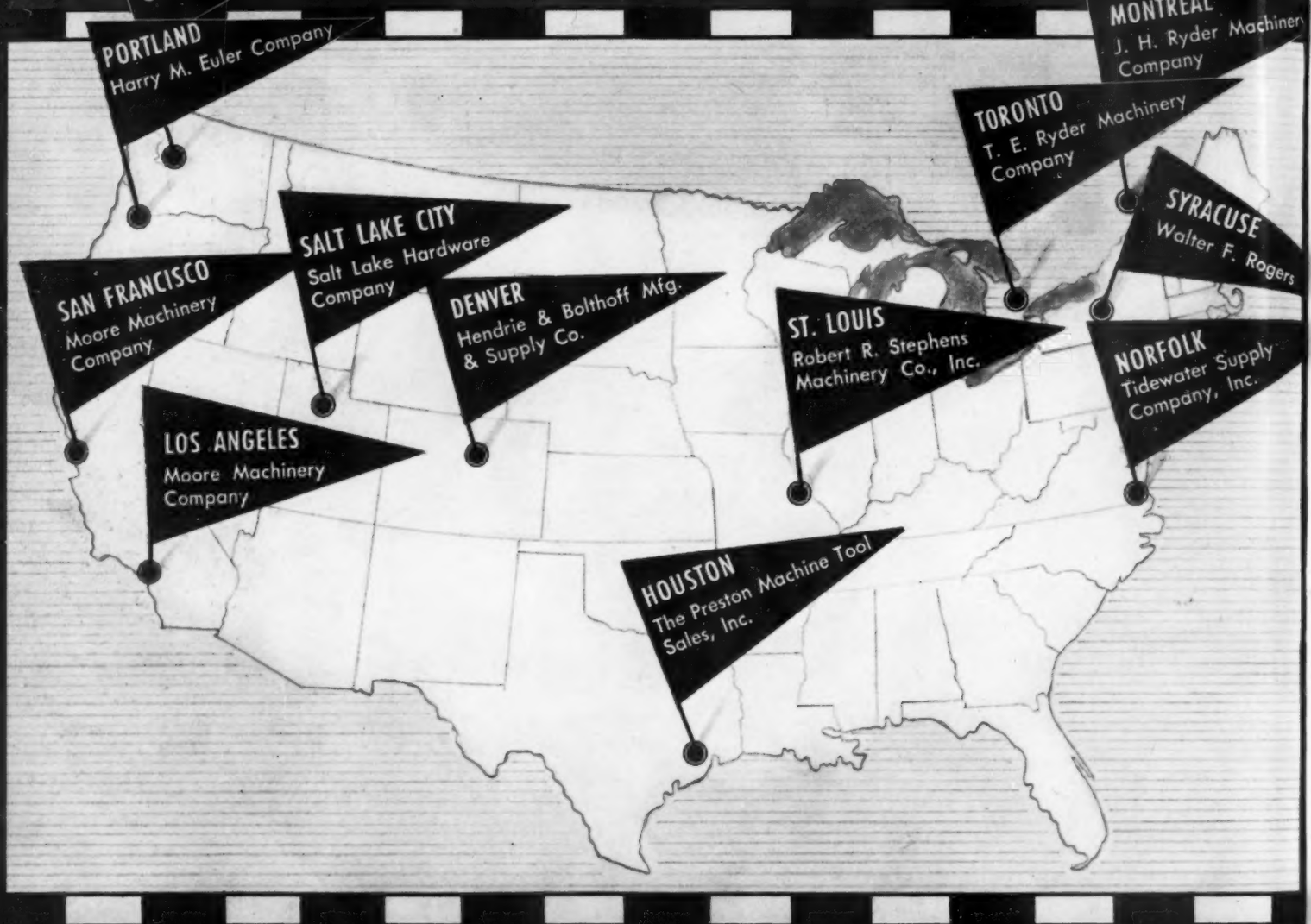
AMERICAN MACHINIST



ARMAMENT: Smart Tooling Spurs the Mustang — Page 905

Heald nation-wide *Service* dealers



In addition to our nine Heald engineering and service branches that are ready to assist you in your precision problems, other industrial areas are fully covered by our service dealers.

They are in a position to assist on internal grinding, precision boring, facing, turning, or in fact, glad to help on any job where accuracy and finish are requirements. Their representatives are in close touch with the Heald engineers and factory at Worcester and have at their fingertips all of our experience and records covering precision finishing for over forty years.

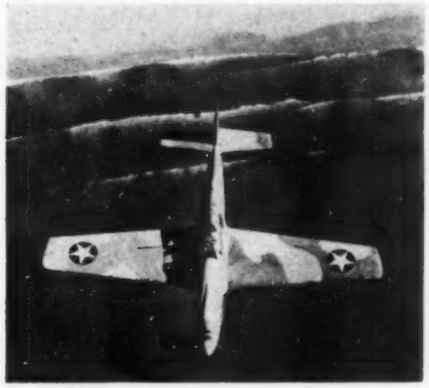
The dealers listed above are anxious to serve you and it is to your advantage to use their time.

THE HEALD MACHINE CO. WORCESTER, MASS. U. S. A.

Manufacturers of Precision Grinding and Boring Machines

AMERICAN MACHINIST

August 20, 1942



Mustang—Jigs complete with portable tools and rivet boxes give free rein to production of this fast fighter

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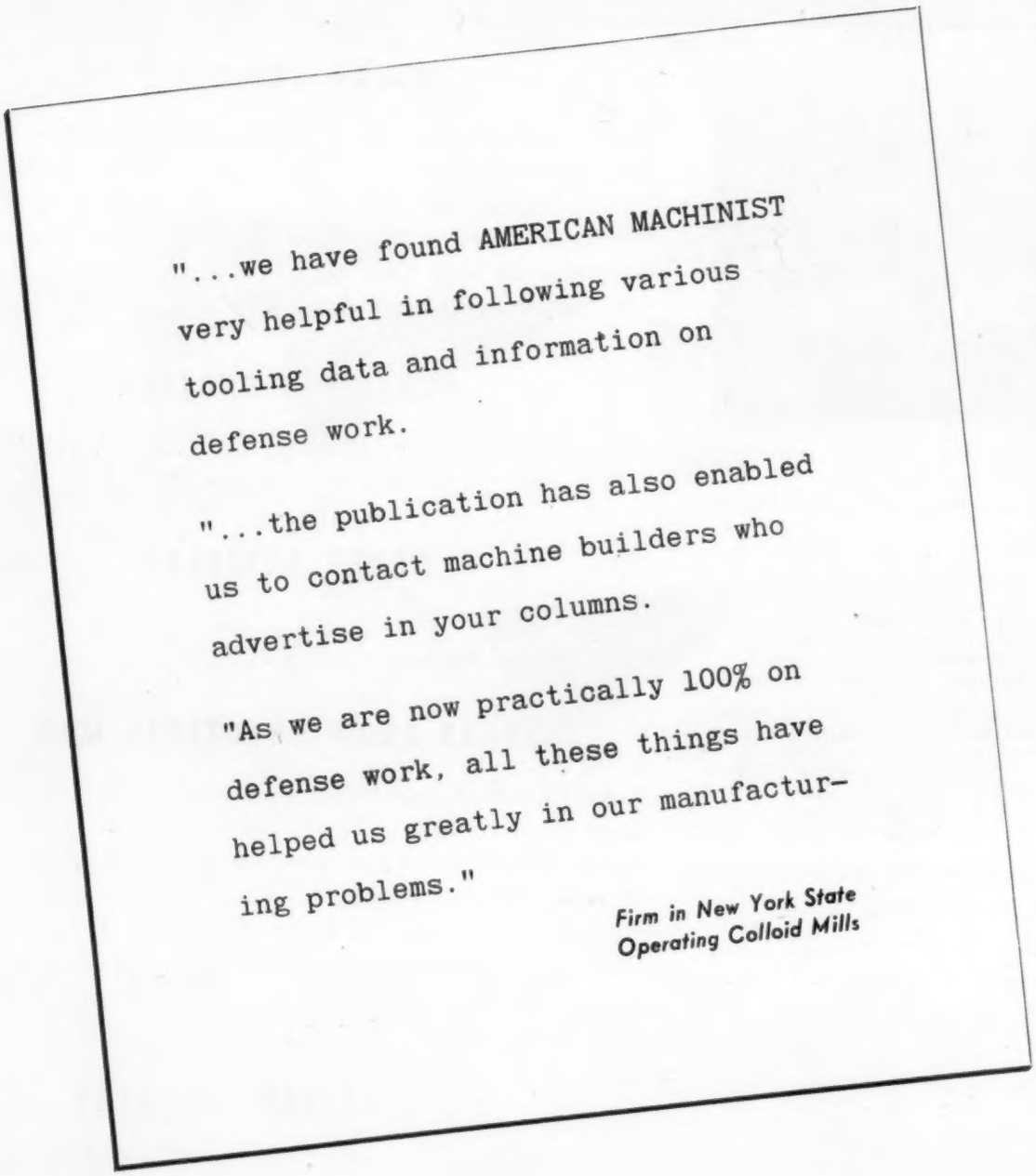


"...we have found AMERICAN MACHINIST very helpful in following various tooling data and information on defense work.

"...the publication has also enabled us to contact machine builders who advertise in your columns.

"As we are now practically 100% on defense work, all these things have helped us greatly in our manufacturing problems."

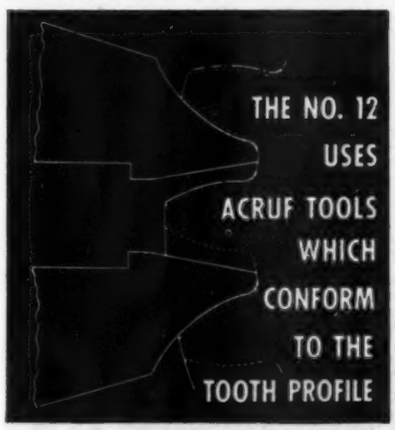
Firm in New York State Operating Colloid Mills

Another Example of How AMERICAN MACHINIST, with Each Issue Packed full of Helpful Editorial and Advertising, is Serving the Wartime Needs of Metal-Working Production Executives Today

GLEASON NO. 12 TWO-TOOL ROUGHER

With the new No. 12 Rougher, fast and extremely close roughing is extended to straight bevel gears and pinions, both in the smaller lot quantities and with front hubs.

The No. 12 operates without generating roll and uses new Acruf tools which leave only a small amount of stock over the entire tooth surface to be removed in finishing. With minor changes in the cycle of the finishing machine, a better tooth finish at savings in finishing time from 35 to 50 per cent is obtained on gears which have been Acrufed on the No. 12.



Send prints together with quantity requirements for complete information on how this new Rougher can reduce your gear cutting costs.

SPECIFICATIONS

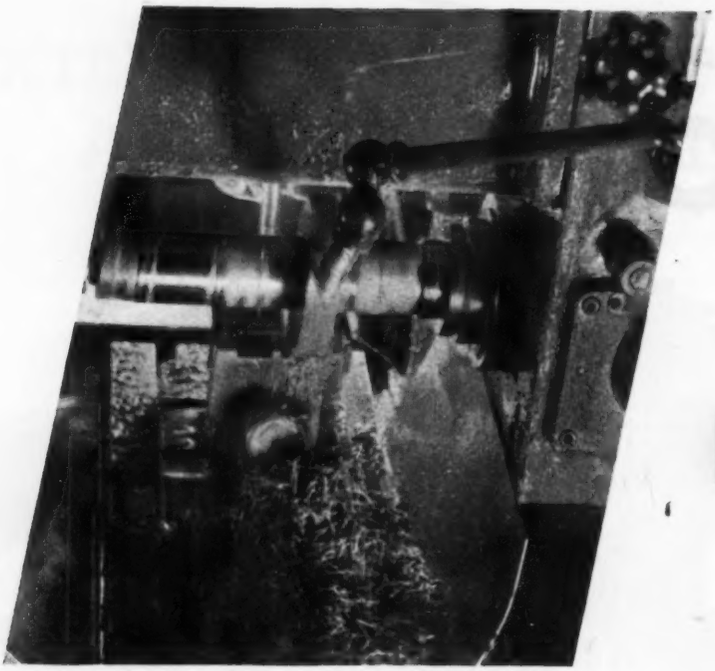
Maximum Pitch Diameter	**18″**
Ratios	**1-1 to 10-1**
Coarsest Pitch	**4 D.P.**
Maximum Face Width	**2½″**
Index Range	**5 to 200 teeth**
Floor Space	**63″ x 89″**

GLEASON

GLEASON WORKS

Builders of Bevel Gear Machinery for Over Seventy-five Years

1000 UNIVERSITY AVENUE, ROCHESTER, N. Y., U. S. A.



IF IT'S FAST

The CINCINNATI No. 0-8 Plain Automatic Milling Machine is ideal for milling innumerable small parts for airplanes, range finders, tanks, instruments, photographic equipment, small arms, fuses, and hundreds of other essential items.

WIN *with a Cincinnati!*

CINCINNATI

ECONOMICAL OPERATION

YOU WANT

BUY CINCINNATI NO. 08 PLAIN AUTOMATIC MILLING MACHINES

Today the value and desirability of a milling machine lies in its ability to out-perform other types of machines on various classes of work; to do it at the lowest possible operating cost — to mill to close tolerances and to handle a wide range of milling operations.

Such a miller is the CINCINNATI No. 0-8 Plain Automatic Milling Machine equipped with automatic Rise and Fall Spindle Carrier.

You'll be interested in the production possibilities of this versatile machine which was designed to mill an exceedingly wide range of small parts fast, economically and accurately.

It is especially desirable for milling operations where it is not possible for the work to traverse directly into the cut. The automatic Rise and Fall Spindle Carrier is timed with table movement and makes possible an almost unlimited number of automatic operating cycles.

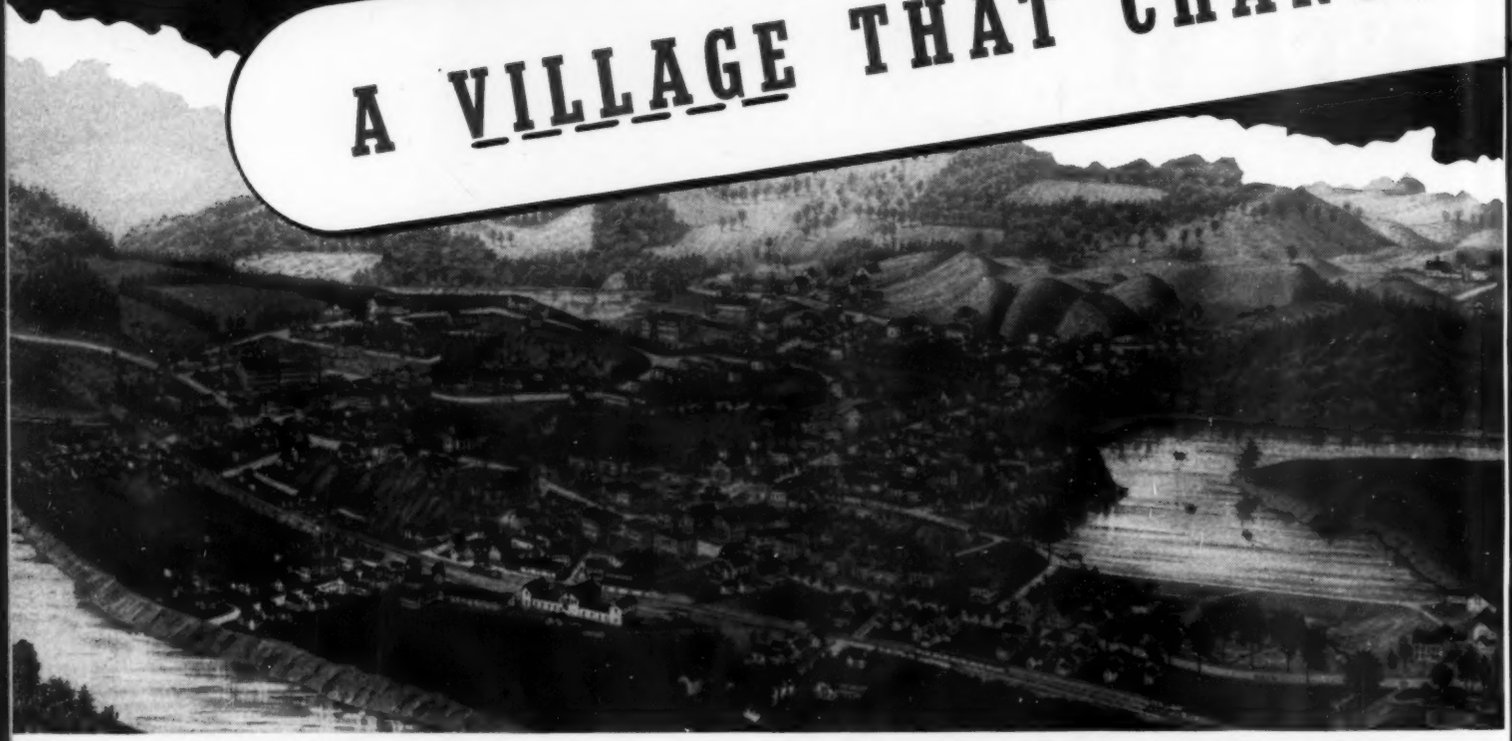
You're going to like the CINCINNATI No. 0-8 for your small parts work. Full details on all features and their benefits are covered in Specification Catalog M-964. Send for your copy today.

THE CINCINNATI MILLING MACHINE CO.

Cincinnati, Ohio U. S. A.

TOOL ROOM AND MANUFACTURING MILLING MACHINES
SURFACE BROACHING MACHINES • CUTTER SHARPENING MACHINES

A VILLAGE THAT CHANGED T

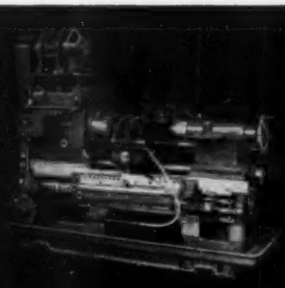


STAND upon the summit of a certain hill in the heart of New England, and beneath you lies a town that has changed the destiny of Man . . . From the village that was there more than a century ago came the weapon that will win this war!

The place is Windsor, Vermont, and the weapon —one of the most complex and wonderful instruments ever perfected—is the modern machine tool.

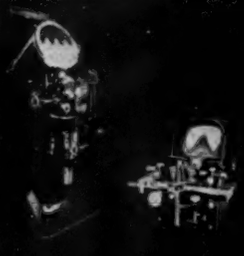
Windsor was the birthplace of the great machine tool industry in America, and the region surrounding it has exerted the most profound influence on our modern industrial age. Known as the Windsor Region, virtually the entire territory lies within a 25-mile radius of the town of Windsor, and includes no more than a dozen towns. Yet a single one of these—Springfield, Vermont, the home of Jones & Lamson—is considered one of the most important spots in the machine tool world.

Because of the machine tools invented and perfected in the Windsor Region, the mass production of automobiles was made possible in America 36 years ago . . . and a giant bomber rolls off the line every 60 minutes in a single plant today.



FAY AUTOMATIC LATHES

AUTOMATIC THREAD GRINDERS



OPTICAL COMPARATORS

AUTOMATIC OPENING DIE HEADS

THE HISTORY OF THE WORLD!

LIKEWISE from a single plant today—Jones & Lamson—have come many of the most important precision machine tools making possible the stupendous record of all-out production established by American industry.

Over a century of cumulative knowledge and experience in the manufacture of precision machine tools has resulted in the present line of Jones & Lamson universal turret lathes, automatic lathes, thread grinding machines, optical comparators, and threading dies being used in the front line of industry today.

Today and after this war, you will be faced with many major problems calling for engineering service . . . Jones & Lamson engineers and operators are at your call today . . . right now!

JONES & LAMSON MACHINE COMPANY

Manufacturers of Ram & Saddle Type Universal Turret Lathes . . . Fay Automatic Lathes . . . Automatic Thread Grinding Machines . . . Comparators . . . Automatic Opening Threading Dies and Chasers

Springfield, *Vermont,* U. S. A.

SADDLE TYPE
UNIVERSAL TURRET LATHE

PROFIT PRODUCING
MACHINE TOOLS

RAM TYPE
UNIVERSAL TURRET LATHE

As a

FELLOWS

Cutting a large diameter internal gear for a 29-ton tank on a 100-inch Fellows Gear Shaper —precision assured by machine and cutter accuracy.

FELLOWS

MACHINES AND TOOLS FOR GEAR PRODUCTION

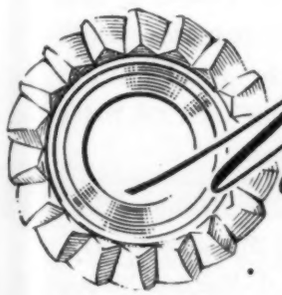
reminder . . .

MAKES MACHINES WITH CAPACITIES FROM 1/16 INCH PINIONS . . . Up!

War jobs have drawn heavily on both ends of the Fellows Gear Shaper line, as well as utilizing the intermediate, 6, 6A and 7-Type sizes. Tiny instrument gears, on the one hand, and heavy duty tank gears on the other—both are "Gear Shaper jobs". Fellows is now making 8 distinct types of Gear Shapers, with a multitude of modifications for special applications.

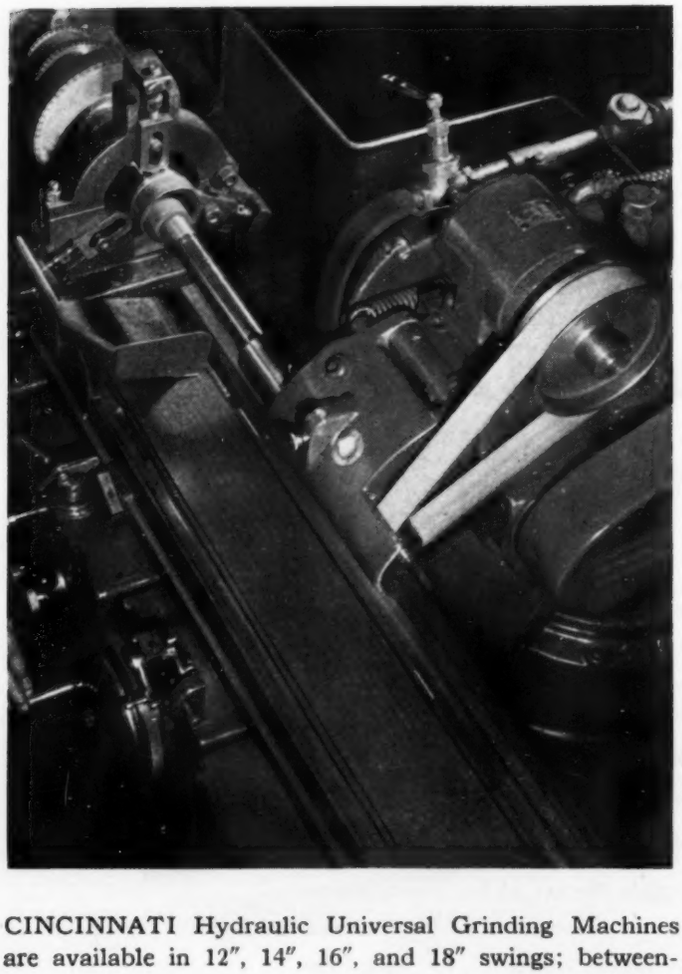
Adaptability, combined with simplicity of design and inherent accuracy in machine and cutter, has made possible the use of the Gear Shaper, which in many cases replaces single-purpose and more costly machines. Cutters can be made in an extreme variety of forms—for work from the simple disking of airplane propeller shaft webs to interrupted toothed contours in many shapes and sizes.

If you have a production job of duplicating contours to precision standards, don't overlook the Fellows Method. To refresh your mind as to its versatility, ask for a copy of our newly reprinted 64-page booklet—"The Fellows Method". Write: The Fellows Gear Shaper Company, Springfield, Vermont—or 616 Fisher Building, Detroit, or 640 West Town Office Building, Chicago.



Method

. . . . FROM BLANK TO FINISHED GEAR



CINCINNATI Hydraulic Universal Grinding Machines are available in 12", 14", 16", and 18" swings; between-center distances up to 72". There is a CINCINNATI Hydraulic Universal to meet your full requirements.

IF IT'S

FAST E

. . . BUY CINCINNATI H

CINCINNATI Hydraulic Universals will turn out your toolroom grinding and general manufacturing work speedily, accurately, and at the lowest possible cost.

These grinding machines are capable of doing twice as much as machines of an older type and doing it more accurately — tolerances of .0002" being practical and easily achieved. Many constructional features you'll want to know about contribute to the productivity, accuracy and exceedingly low operating cost of these Hydraulic Universal Grinding Machines.

You can depend on CINCINNATI Hydraulic Universal Grinding Machines to give you Faster Set-Up, Faster Handling, Faster Grinding and Faster Sizing with maintenance expense reduced to the point where it ceases to be a consideration.

CINCINNATI

ECONOMICAL OPERATION

YOU WANT

HYDRAULIC UNIVERSAL GRINDING MACHINES

You'll be interested in the exclusive features and production possibilities of these precision grinding machines. Specification catalogs G-486 and G-474 give complete information on all features and why they will prove beneficial to you. Send for your copies today.

WIN *with a Cincinnati!*

CINCINNATI GRINDERS INCORPORATED

Cincinnati, Ohio U. S. A.

CENTER TYPE GRINDING MACHINES • CENTERLESS GRINDING MACHINES
CENTERLESS LAPPING MACHINES

VAN NORMAN
Milling Machines

VAN NORMAN

Directional Control of all Power Feeds, Simplifies Operation

OF VAN NORMAN MILLERS

Table control levers. Push towards right side of miller to move table to the right, towards left side of miller to move table to left.

Saddle control levers. Move towards front of machine to move saddle forward, push towards rear of machine to move saddle back.

Knee control levers. Lift to raise knee, push down to lower knee.

It is easy for the apprentice to learn and the skilled operator to remember that the table, knee and saddle of any Van Norman Miller travels in the same direction that the control levers are moved.

For example, if the operator is standing in front or rear of the machine and wishes to move the table to the right, he moves the table control lever to the *right*, if he wants to raise the knee, he *lifts* the control lever for the knee, if he wants to lower the knee, he pushes this same lever *down*.

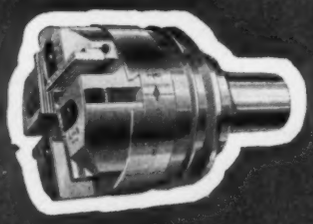
From *either front or rear*, the operator has complete directional control of *all* power feeds,—simple, practical and time-saving. Add to this feature, the front and rear control of feed selection by a single lever, as well as front and rear control of 6-way power rapid traverse and you will see why operators prefer Van Norman Millers.

★ *In June, 1942, Van Norman was awarded the Army and Navy Star in recognition of its war production record.*

MACHINE TOOL CO., SPRINGFIELD, MASS.

Landis Weapons For

CHASER



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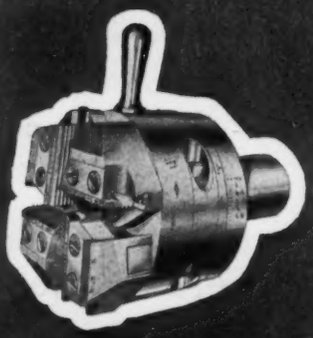
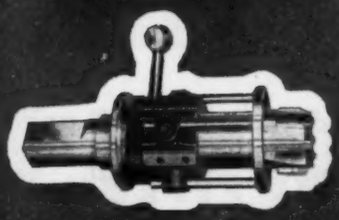


LANDMATIC HEAD



COLLAPSIBLE TAP

The LANDIS TRADE-MARK REG. U.S. PAT. OFF. Line

THREAD CUTTING MACHINES
- Landmaco Threading Machines
- Bolt Factory Threaders
- Automatic Forming and Threading Machines
- 4 Spindle Semi-Automatic Threading Machines
- Pipe and Nipple Threading Machines

THREAD CUTTING DIE HEADS
- Landmatic (for Turret Lathes and Screw Machines)
- Landex (for Automatic Screw Machines)
- Lanco (for Automatic, Semi-Automatic and Hand-Operated Threading Machines)
- Lanco Pipe and Nipple Threading Heads
- Stationary Pipe Die Heads
- Reverse Taper Die Heads
- Standard Rotary Die Heads

PRECISION THREAD GRINDERS

PIPE THREADING AND CUTTING MACHINES

ROLLER PIPE CUTTERS

CHASER GRINDERS

COLLAPSIBLE AND ADJUSTABLE TAPS

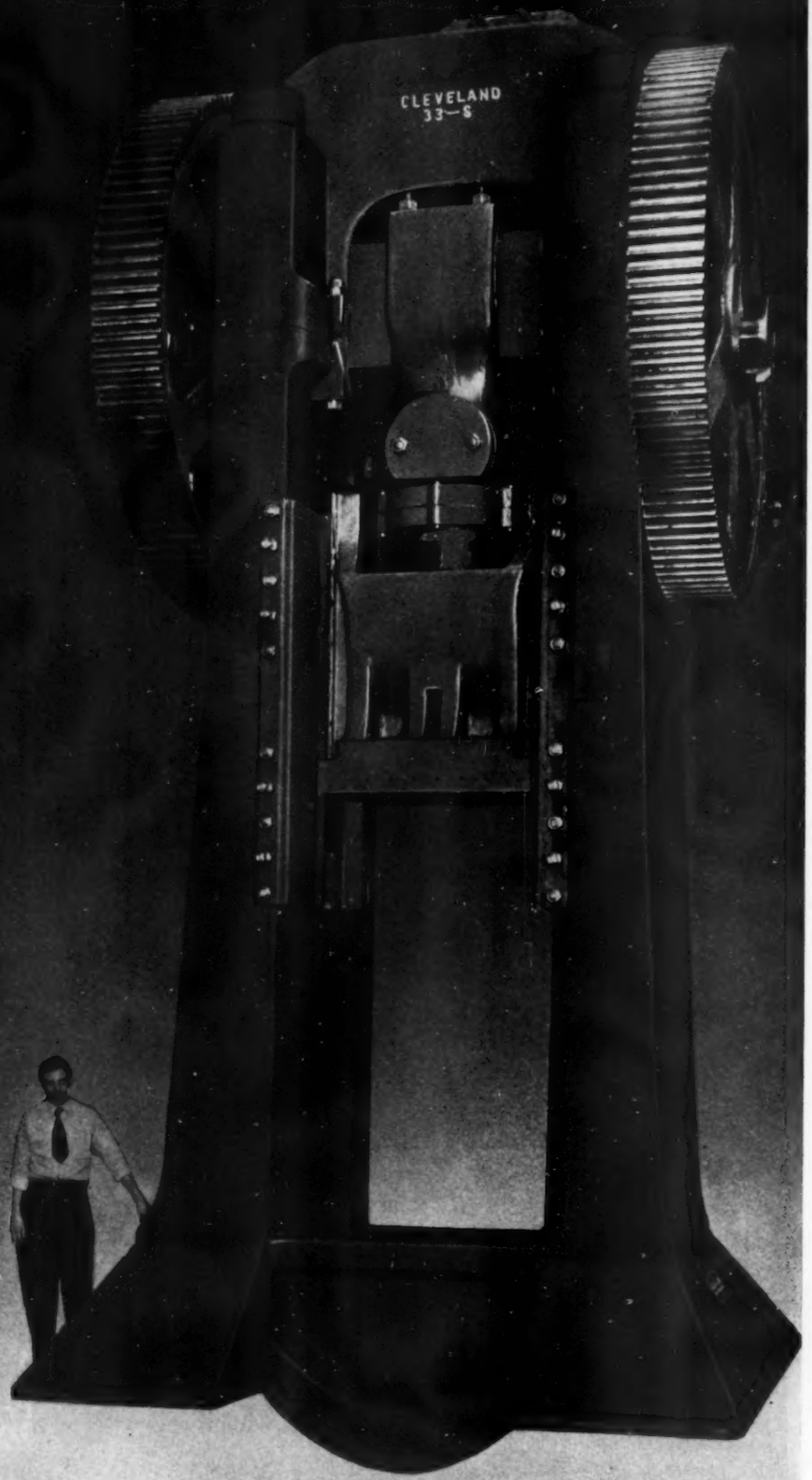
LANDIS MACHINE COMPANY, WAYNESBORO, PENNA, U.S.A.

War Production Soldiers

Manufacturers of Anti-Aircraft and other types of shells easily maintain unusually high production schedules by employing the LANDMACO Shell Tapper for tapping the nose end—to the close tolerances established—of these vital components of our war effort.

Write for Bulletin
"Be Threadwise
LANDI*Size*"

1500 TONS CAPACITY



AND AS LARGE AS THE NEED DEMANDS

Cleveland Straight Sided Single Crank Presses can be furnished in Capacities ranging from 75 tons to 1500 tons, which is the rated capacity of this 33 S, and in sizes to suit requirements.

Furthermore, as was the case with this particular Press, which was enlarged to provide a greater amount of space between the slide and the bed, the standard specifications can, in many instances, be altered to meet a particular need.

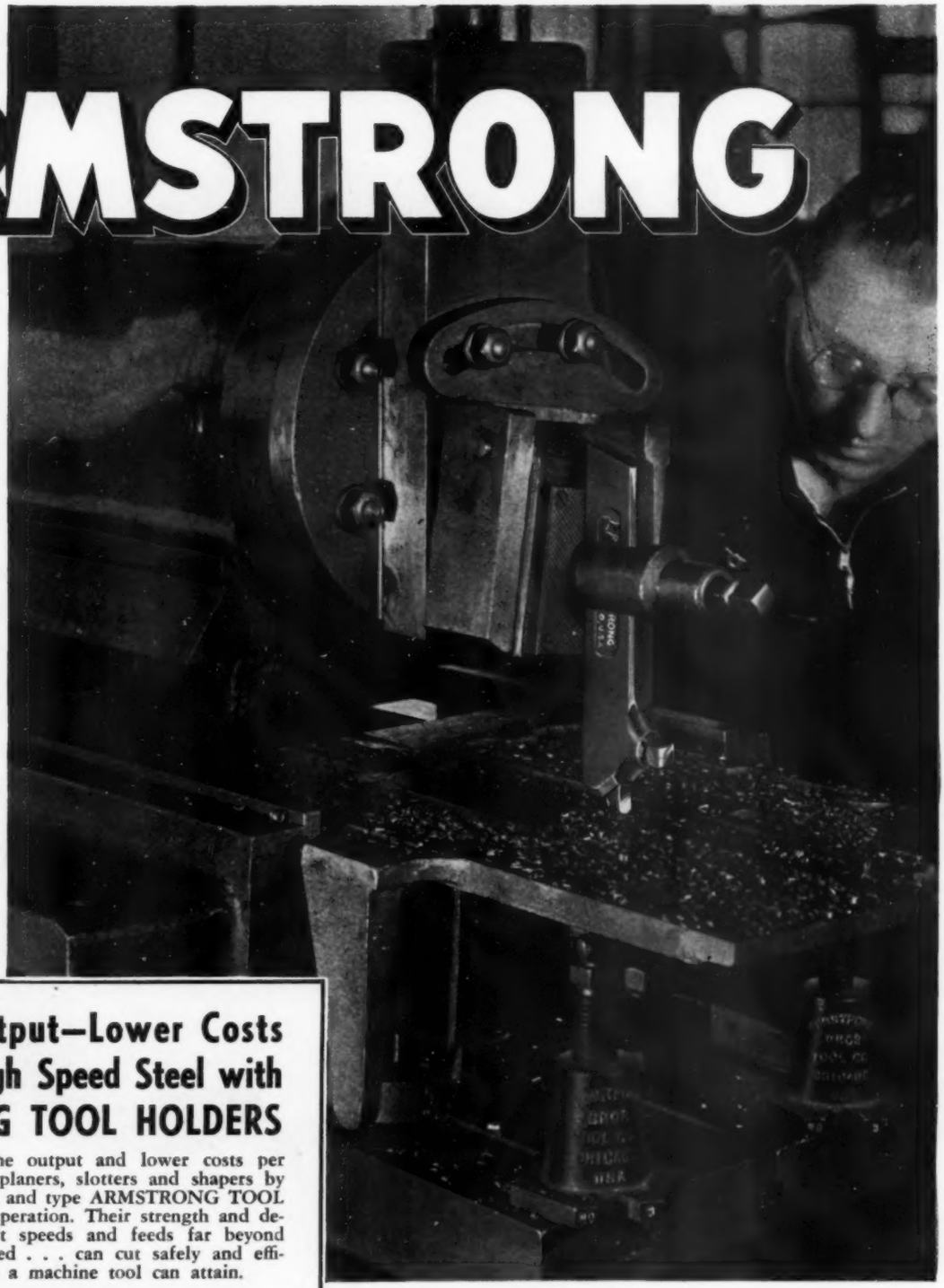
This Cleveland 33 S, which is double geared, is equipped with an air friction clutch and brake having two station electrical control, and the flywheel is provided with a separate air clutch which is used to bring it to a quick stop.

There are thirteen types of Cleveland Presses for the PRESSING NEEDS of Industry.

Modern Presses THE CLEVELAND PUNCH & SHEAR WORKS COMPANY

NEW YORK • CHICAGO • DETROIT • PHILADELPHIA • PITTSBURGH

ARMSTRONG



Increase output—Lower Costs and Save High Speed Steel with ARMSTRONG TOOL HOLDERS

You can increase the output and lower costs per piece on all lathes, planers, slotters and shapers by using the correct size and type ARMSTRONG TOOL HOLDER for each operation. Their strength and design efficiency permit speeds and feeds far beyond those customarily used . . . can cut safely and efficiently at any speeds a machine tool can attain.

Then there is the tremendous saving of high speed steel—an initial saving of 90% because each ounce of high speed steel used in an ARMSTRONG TOOL HOLDER will cut as much steel as 10 ounces in a forged tool. Because the entire "Armstrong System" is based on cutter bits of standard high speed steel shapes, the same high speed steel cutter can, when conditions warrant it, be used in a number of different ARMSTRONG TOOL HOLDERS *each of which will do the work of a complete set of forged tools!*

If you want to turn out more, turn it out faster and do your part in making the country's limited supply of high speed steel outlast the war, use ARMSTRONG TOOL HOLDERS wherever possible.

ARMSTRONG BROS. TOOL CO.

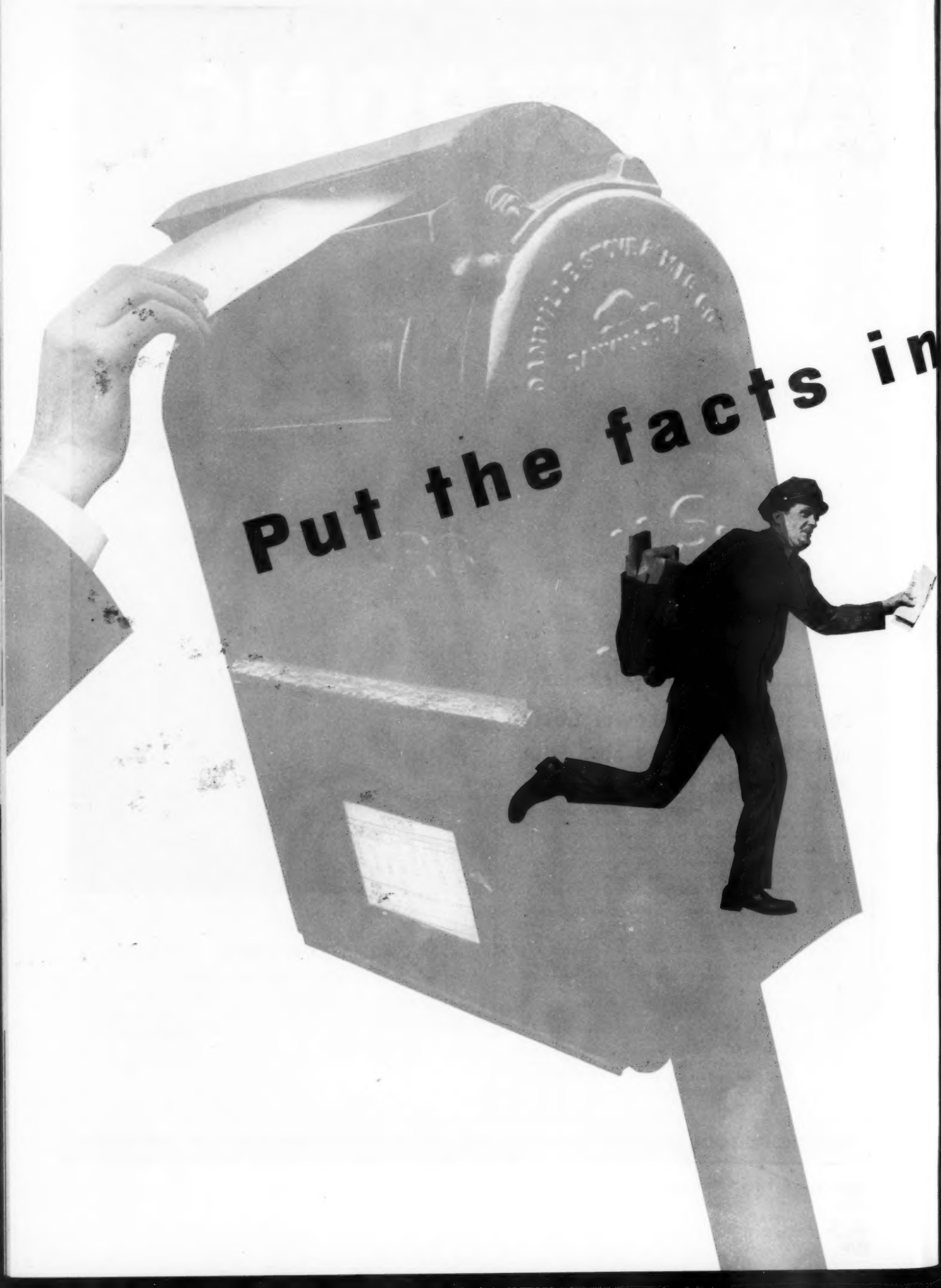
"The Tool Holder People"

315 N. Francisco Ave. **Chicago, U. S. A.**

Eastern Warehouse & Sales:
199 Lafayette St., New York

Buy ARMSTRONG TOOLS from your Supply House

ARMSTRONG TOOL HOLDERS Are Used in Over 96% of the Machine Shops and Tool Rooms


Put the facts in a

a letter to Bryant

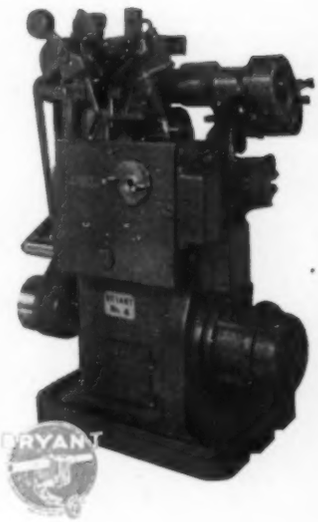
We may *think* we have only one problem. That problem of course is war production. To help solve it, Bryant productive capacity, already tripled, is constantly increasing.

But right now, today, we already have another problem, and that problem is to find new markets for American products, the moment peace returns.

If we are going to solve this problem we must find new ways to make more and better things that more and more people will be glad to buy for less and less money.

If we are going to solve this problem in time, we better start solving it now.

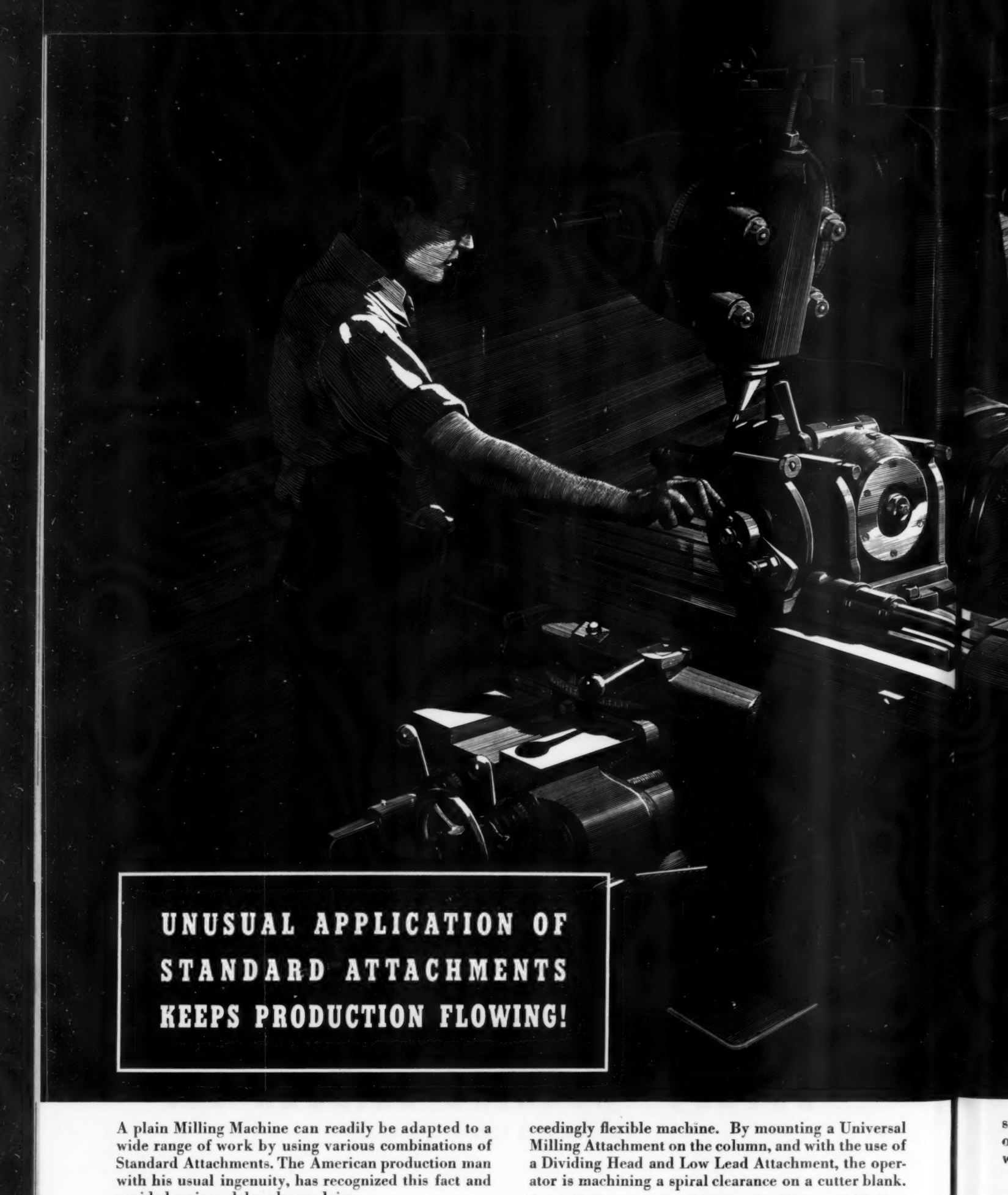
Probably you have already started. If your plans include jobs with internal grinding, it should pay to put the facts in a letter to Bryant. Just as Bryant engineers have found so many ways to combine operations, cut costs and speed war production, so can they be expected to point the way to new profits on your future business.



And all the greater should be Bryant's opportunity to render substantial assistance if allowed to work with you at the earliest possible stages. By all means sit down today and put the facts in a letter to Bryant.

BRYANT CHUCKING GRINDER CO.

SPRINGFIELD, VERMONT, U. S. A.



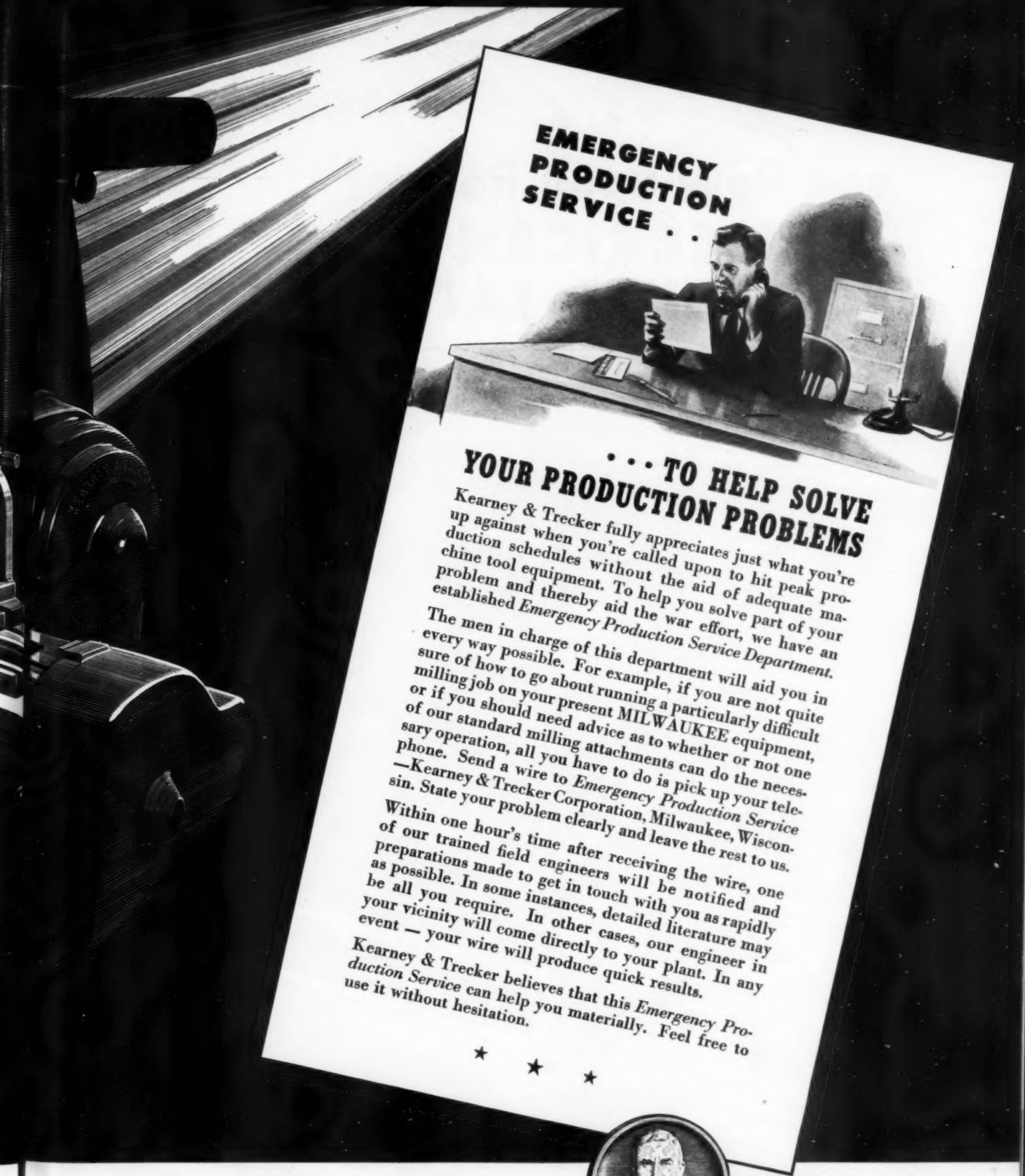
UNUSUAL APPLICATION OF STANDARD ATTACHMENTS KEEPS PRODUCTION FLOWING!

A plain Milling Machine can readily be adapted to a wide range of work by using various combinations of Standard Attachments. The American production man with his usual ingenuity, has recognized this fact and avoided serious delays by so doing.

Here's an instance where an unusual application cracked a production problem. In the illustration above, a plain type "Milwaukee" has been converted into an exceedingly flexible machine. By mounting a Universal Milling Attachment on the column, and with the use of a Dividing Head and Low Lead Attachment, the operator is machining a spiral clearance on a cutter blank.

Instead of waiting for delivery of a Universal Milling Machine, this customer was able to get into production rapidly by using this method. What's more, it was found that these same attachments could be used for

Milwaukee MACHINE



EMERGENCY PRODUCTION SERVICE . .

. . . TO HELP SOLVE YOUR PRODUCTION PROBLEMS

Kearney & Trecker fully appreciates just what you're up against when you're called upon to hit peak production schedules without the aid of adequate machine tool equipment. To help you solve part of your problem and thereby aid the war effort, we have an established *Emergency Production Service Department.*

The men in charge of this department will aid you in every way possible. For example, if you are not quite sure of how to go about running a particularly difficult milling job on your present MILWAUKEE equipment, or if you should need advice as to whether or not one of our standard milling attachments can do the necessary operation, all you have to do is pick up your telephone. Send a wire to *Emergency Production Service* —Kearney & Trecker Corporation, Milwaukee, Wisconsin. State your problem clearly and leave the rest to us.

Within one hour's time after receiving the wire, one of our trained field engineers will be notified and preparations made to get in touch with you as rapidly as possible. In some instances, detailed literature may be all you require. In other cases, our engineer in your vicinity will come directly to your plant. In any event — your wire will produce quick results.

Kearney & Trecker believes that this *Emergency Production Service* can help you materially. Feel free to use it without hesitation.

★ ★ ★

spiral fluting, angle and vertical milling, and a variety of other jobs. The cost of this equipment, by the way, was *less than half* the price of a new machine.

Write for complete information on the various types of Attachments and Accessories which will increase the range of usefulness of your present Milwaukee equipment.

KEARNEY & TRECKER CORPORATION
MILWAUKEE, WISCONSIN

Kearney & Trecker has just completed a new visual training course titled "Milling Practice".

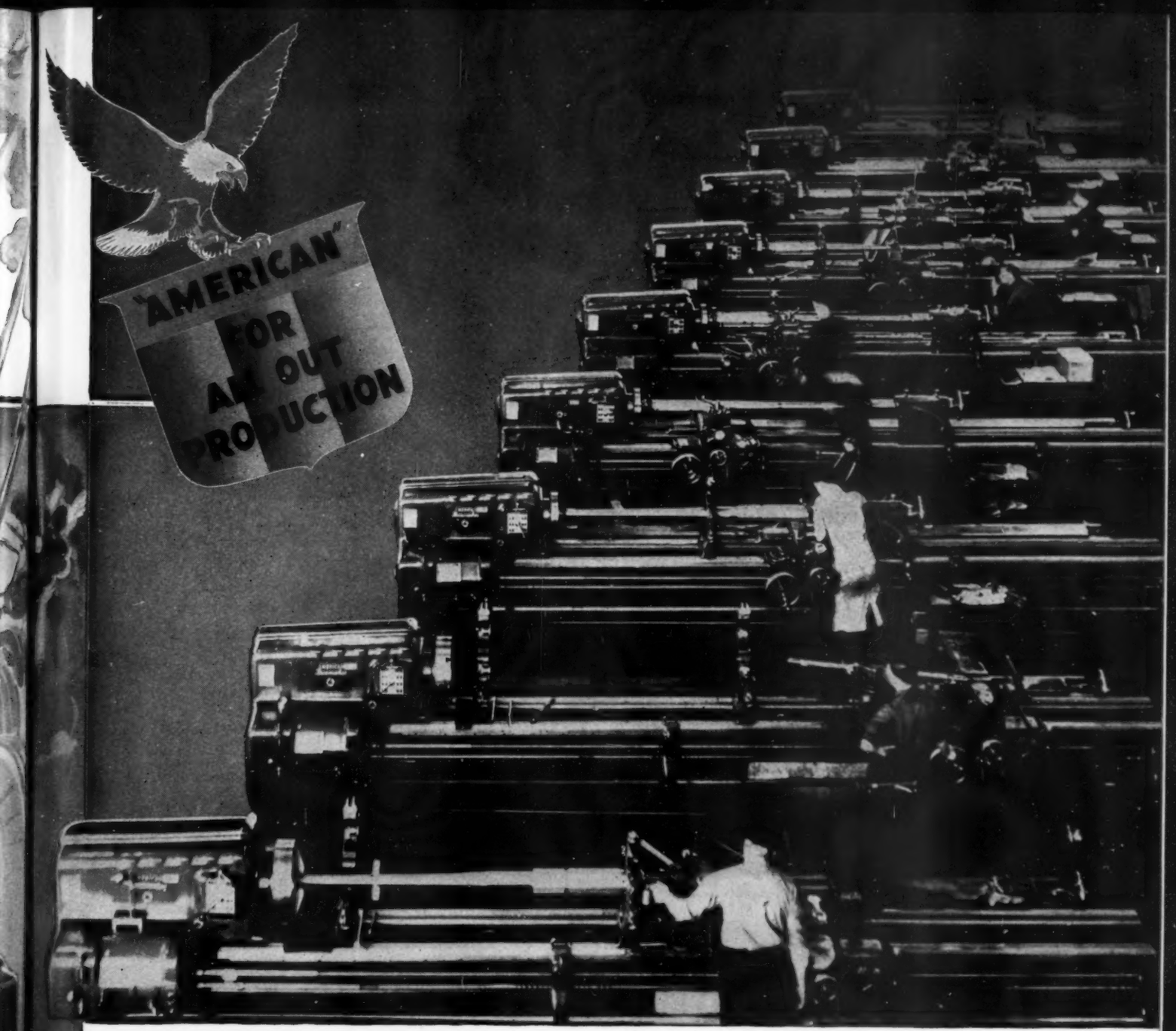
You may obtain it on a rental basis or purchase it outright. For further details write Dept. B.

KEARNEY & TRECKER
CORPORATION

T O O L S

Guns by the Thousands!!

and Row upon Row of "AMERICAN" PACEMAKER LATHES



...producing them in the Plant of THE DOMINION ENGINEERING CO.

Our fighting forces need guns and more guns and they are getting them in ever increasing numbers.

In the gun plants of this country and Canada "AMERICAN" Lathes are meeting every challenge of increased schedules. They are producing as they never produced before and at the same time are maintaining amazing standards of accuracy.

For all-out production, call on "AMERICAN".

THE AMERICAN TOOL WORKS COMPANY

Lathes - Radials - Shapers

CINCINNATI, OHIO, U. S. A.

SAFE FROM T

THE ACK-ACKS . .

but breathing sea-level air

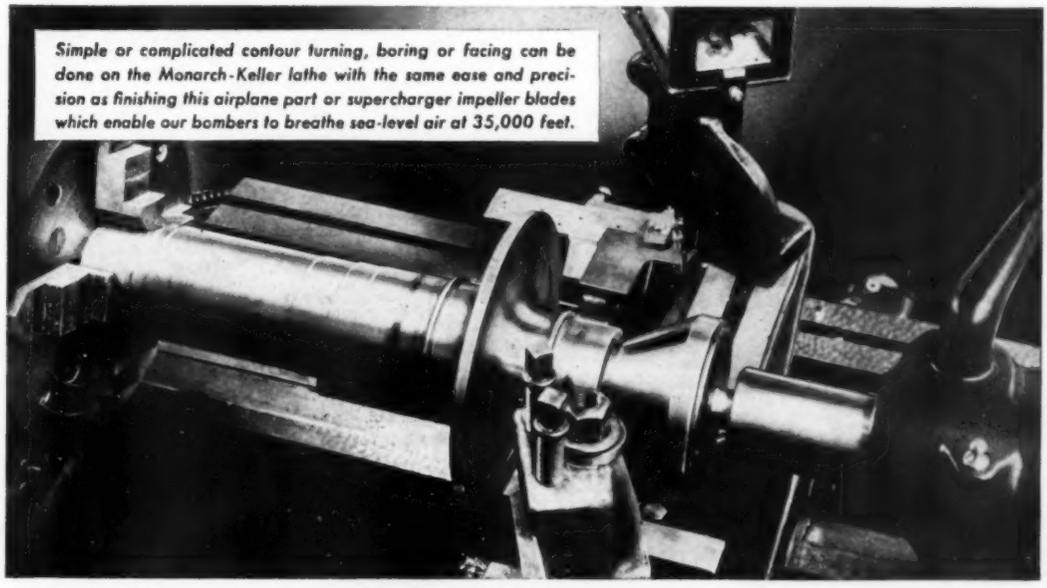
American bombers can maneuver at 35,000 feet—safely above effective anti-aircraft fire. But motor efficiency calls for dense air, so a supercharger is used to compress the thin high-altitude air to sea-level density.

Many supercharger parts, such as impellers, call for finest and most accurate finish, which is accomplished on Monarch-Keller lathes four to five times faster than by any other means.

The impeller is held in a fixture fastened to the faceplate. A single-point tool machines the outer edge to an angle and a blended radius. With electric controls, the tool is guided automatically by a thin metal template to follow exactly the contour required to give the impeller maximum efficiency and dependability.

Electric controlled Monarch lathes are performing intricate contour jobs in hundreds of war plants with dependability and speed. You, who are using Monarch lathes to produce implements of Victory, can do so with the assurance that they'll never let you down!

THE MONARCH MACHINE TOOL COMPANY • • • SIDNEY • OHIO



Simple or complicated contour turning, boring or facing can be done on the Monarch-Keller lathe with the same ease and precision as finishing this airplane part or supercharger impeller blades which enable our bombers to breathe sea-level air at 35,000 feet.

MONARCH LATHES

COVER THE TURNING FIELD

...1500% is a lot of percent, Joe!

Dear Joe: Madison, Wisconsin

If what goes on around here is any fair sample, we're really getting down to brass tacks about winning this war!

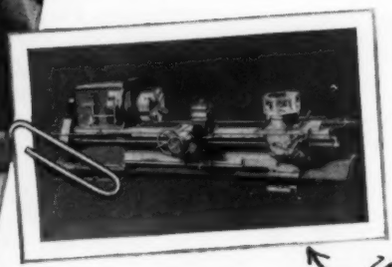
Herr Hitler isn't going to like this. But believe it or not, we're increasing production 1500% on our large sized turret lathes. That's a lot of percent, Joe! You can understand what it means in greater capacity to cut metals in the plants that are making tanks, guns, shells, trucks, and all the other equipment you fellows need.

Of course, it takes more floor space to do this. So we built a new addition to the old Northern Works. And the whole works will be devoted to building these two special "Victory" models. Actually, they're modified versions of the standard 3-L and 4-L Saddle Type jobs.

We're hard at it, Joe, working day and night. And we'd never have believed we could do so much in the time we've had. If news like this doesn't bring you a smile of confidence, we miss our guess.

Best of luck.

The fellows at Gisholt

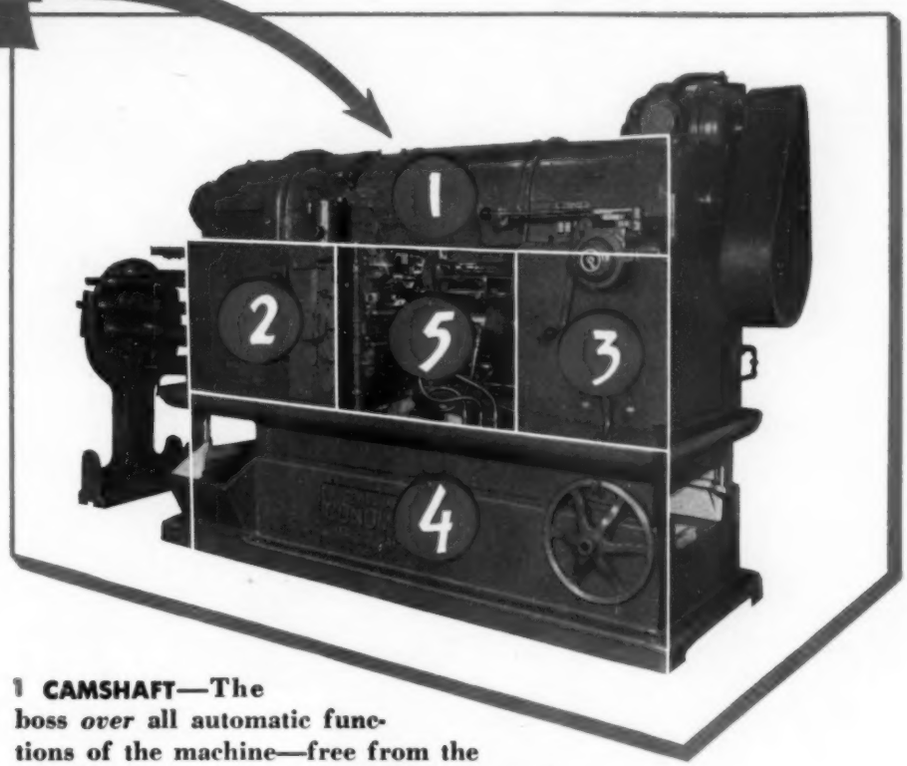


We're building the new "Victory" models in two sizes, 21" and 24" chucks; 5¼ and 9¼ spindle bores

GISHOLT

IT'S good news on the firing lines—or on the production lines! Get the facts about what Gisholt is doing to increase production in vital war plants—how Gisholt is helping to solve one of today's most pressing problems.

Boss OVER 5 ORDERLY DEPARTMENTS



1 CAMSHAFT—The boss *over* all automatic functions of the machine—free from the interference of coolant, falling chips and dirt, yet easily accessible for quick cam changes.

2 WORK HEAD—Rigid, compact unit for spindle carrier and cross-slide support.

3 GEAR BOX—Large, right end support housing the accessible speed and feed change gears.

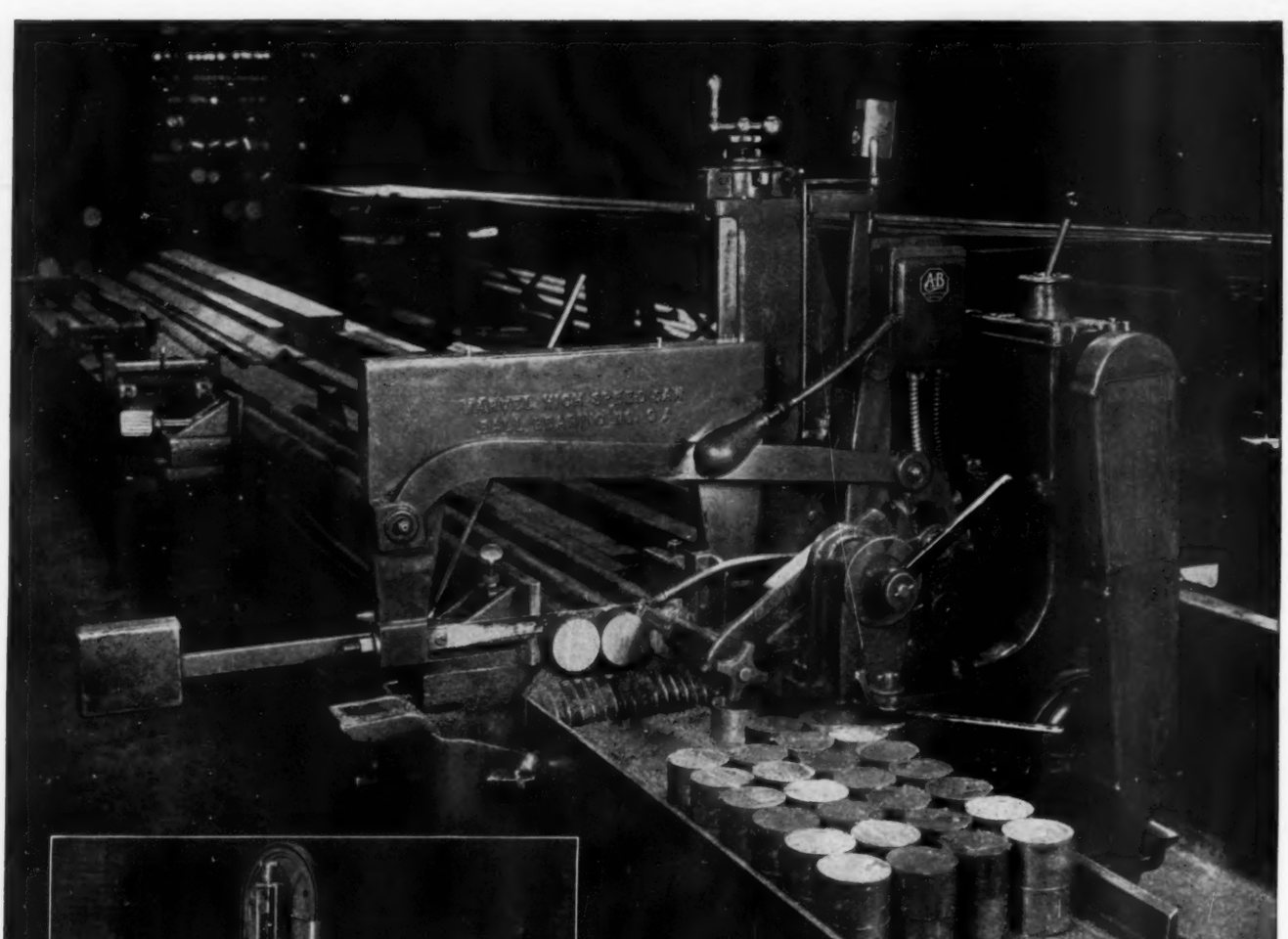
4 BASE—Rugged—roomy for chips and coolant reservoir.

5 PRODUCTION AREA—Spacious and convenient—where departmental arrangement proves its value in accurate, quality work.

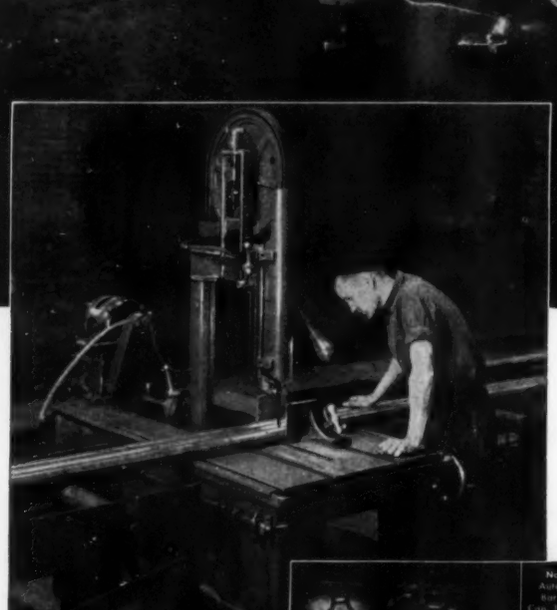
Conomatic design has always been appreciated by the production man and experienced operator—it is of vital importance in training new operators.

Write, wire, or phone for further information.

CONE AUTOMATIC MACHINE CO., INC.
WINDSOR, VERMONT
U. S. A.



MARVEL SAWS



• **No. 9A MARVEL Production Saw automatically cutting-off quantity run — 3 bars at a time. This heavy-duty all-ball-bearing machine cannot be surpassed in speed, simplicity, ruggedness and dependability.**

• **A universal No. 8 MARVEL Metal-cutting Band Saw, that cuts-off, miters, notches or cuts at any angle from 45° right to 45° left. Blade feeds into the work.**

MARVEL SAWS handle orders as they come, at Jones & Laughlin Warehouse

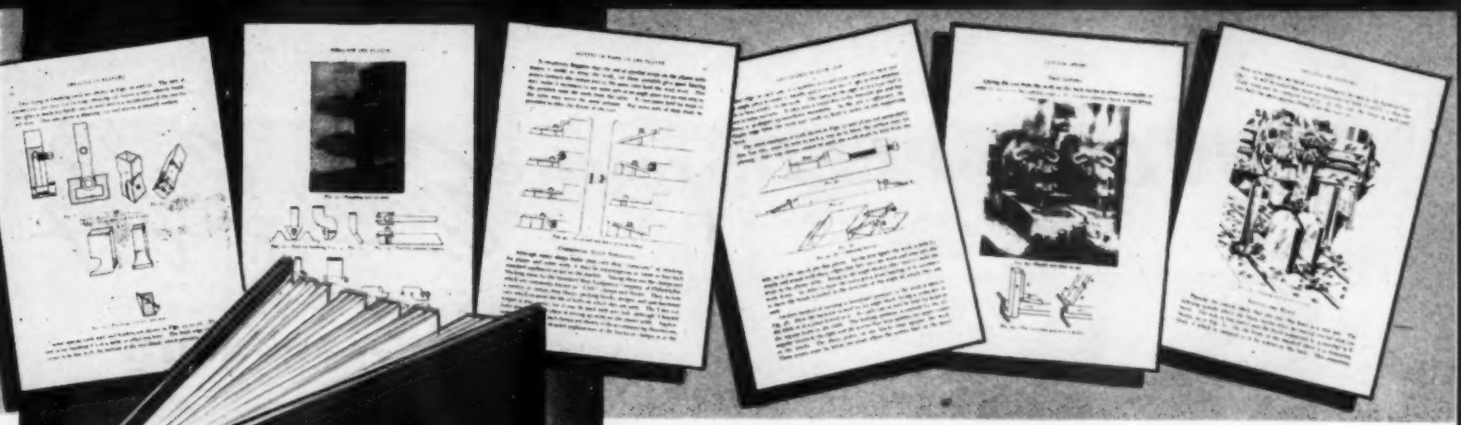
Hot rolled and cold finished steel squares, rounds, hexagons and flats,— single pieces or hundreds of pieces, lengths or slices, small bars or large (to 18" x 18") are cut-off quickly, accurately and efficiently at the Jones & Laughlin Steel Corp. Detroit Warehouse with MARVEL SAWS. "We are very pleased with all machines" sums up their MARVEL experience.

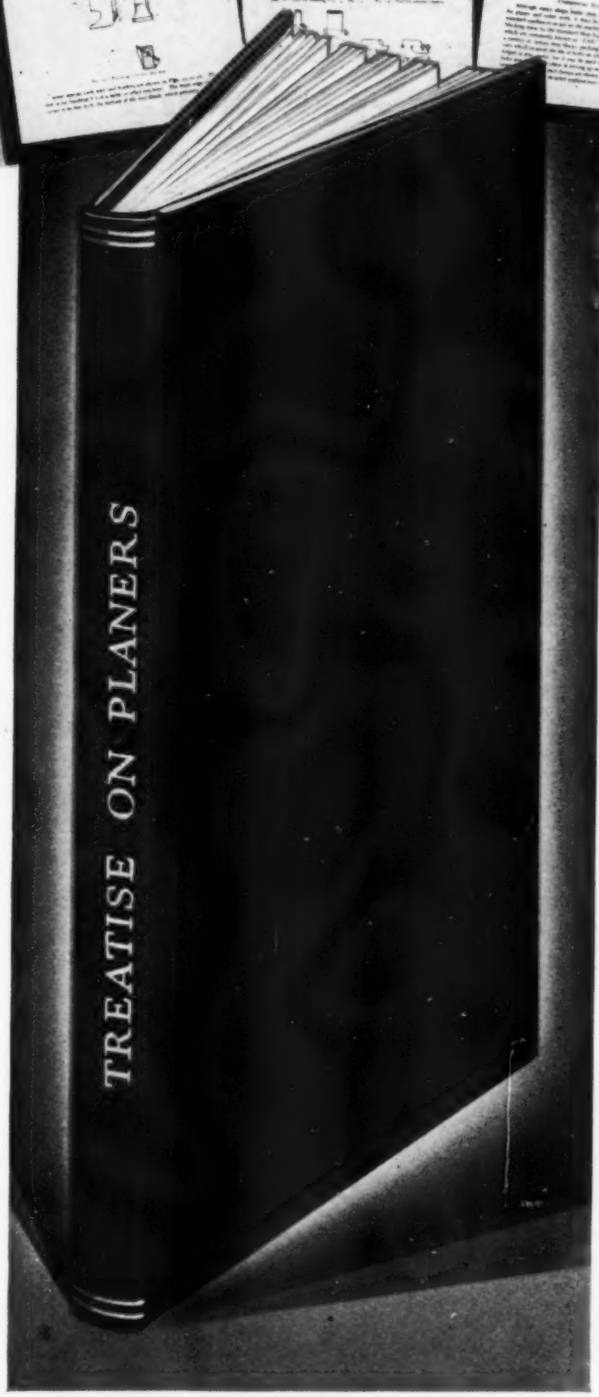
ARMSTRONG-BLUM MFG. CO.

"The Hack Saw People"

5700 Bloomingdale Ave. Chicago, U.S.A.

Eastern Sales Office: 225 Lafayette St., New York





A TREATISE ON PLANERS

★ *Interesting*
★ *Instructive*
★ *Illustrated*

• Here's a book of unusual value both to the apprentice learning to operate planers—to the planer operator and to those responsible for accurate, low cost planer operation.

In addition to a brief history of planer development it contains useful information on the design and construction of the modern planer—tools for planers—planer set-ups—special planer jobs—typical examples of planer work—and types of planers commonly used.

The various subjects are arranged in chapters and are freely illustrated to simplify complete understanding of each point. Cutting speeds and feeds are discussed and many other subjects pertinent to efficient, economical planer operation.

Due to the exceptional value of the material contained in this book, all of which was gained from practical experience, we are making a nominal charge of one dollar ($1.00) per copy. This is a stiff backed, cloth bound book which will serve you for years. If interested enclose a dollar with your request or with the attached coupon. Book will be mailed immediately.

THE CINCINNATI PLANER CO... CINCINNATI, OHIO

CINCINNATI PLANER CO.—CINN., O.
Attached is one dollar ($1.00) for which I am to receive a copy of your book "Treatise on Planers".

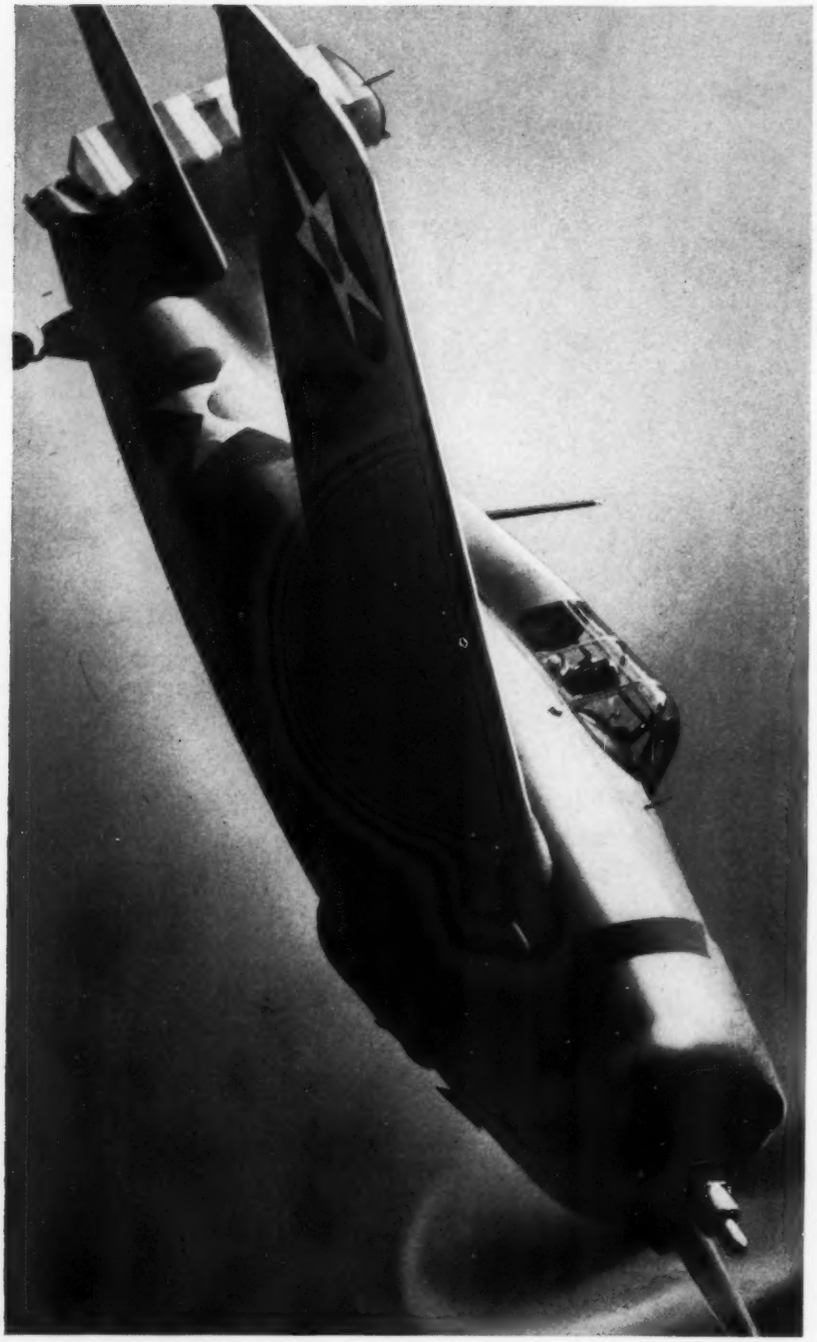
NAME_____ TITLE_____

COMPANY_____

STREET_____

CITY_____ STATE_____

DIVING SPEEDS require *Extra Safety*



. . . as with

MICROHONING

When *diving motors* "rev" up to 5600 r.p.m., the entire success of a mission may depend upon having an extra margin of safety in critical bearing surfaces. These surfaces are not completely safe unless extremely accurate, and "structurally perfect"—entirely free of microscopic cracks and disturbed subsurface material which induce fatigue failure.

MICROFINISH HONING is providing such surface quality in regular high production because—

It does not generate injurious frictional heat—hence avoids cracks.

It does not disturb or weaken subsurface material.

It corrects error and generates accuracy.

It generates any desired type or degree of controlled surface finish smoothness.

It provides all these advantages under the control of a single process.

Write for Bulletin A.R. 67

Micromatic

HONE CORPORATION

DETROIT, MICHIGAN

Manufacturers of Honing Machine Tools

MICROHONING
is used to finish

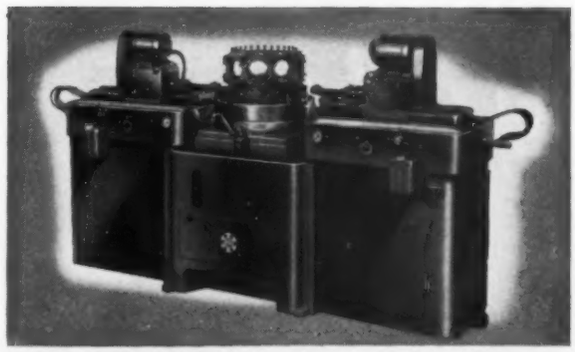
Gun Barrels—before and after rifling—diameters .303" to 18" and lengths up to 75 feet • Gun Recuperators and Engine Cylinders • Wrist Pins • Valve Guides • Con Rods • Bearings • Pneumatic and Hydraulic Cylinders—and many other precision parts for ordnance, aircraft, automotive equipment, tanks, machine tools, etc.

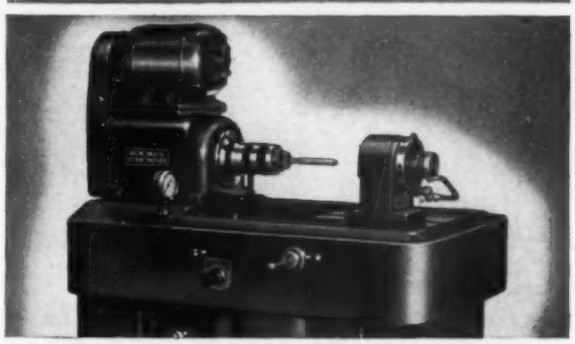
Phone
DETROIT
TRINITY
1-1300

MICROHONING *is now used to generate finished surfaces in many parts—in bores, on shafts, pins, etc.*

SAVE TIME
SAVE METAL
SAVE COST
IMPROVE QUALITY

ENGINES • Honing Valve Guides after assembly in crankcase (Radial Aircraft Engine) on double-end Hydrohoner with Microsize Control. Production—3 to 6 complete assemblies per hour—removes average of .0005″ to .001″—generates uniform size within .0003″ to .0005″, accuracy within .0001″ to .0003″, and surface finish within 3 to 5 microinches r.m.s.



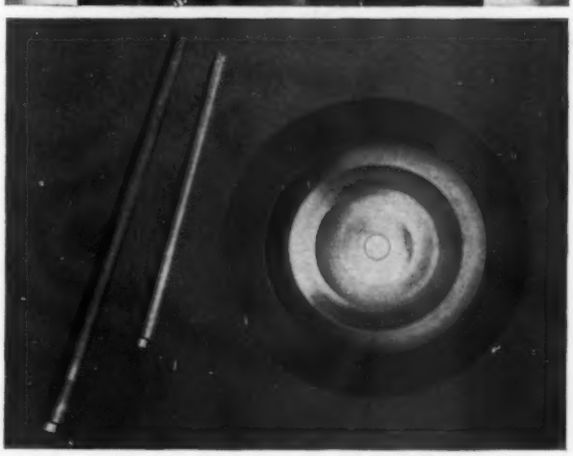


HYDRAULICS • Honing O.D. of pistons for a variable delivery hydraulic pump —with the unusual feature that half the piston surface area is hardened, half is soft.

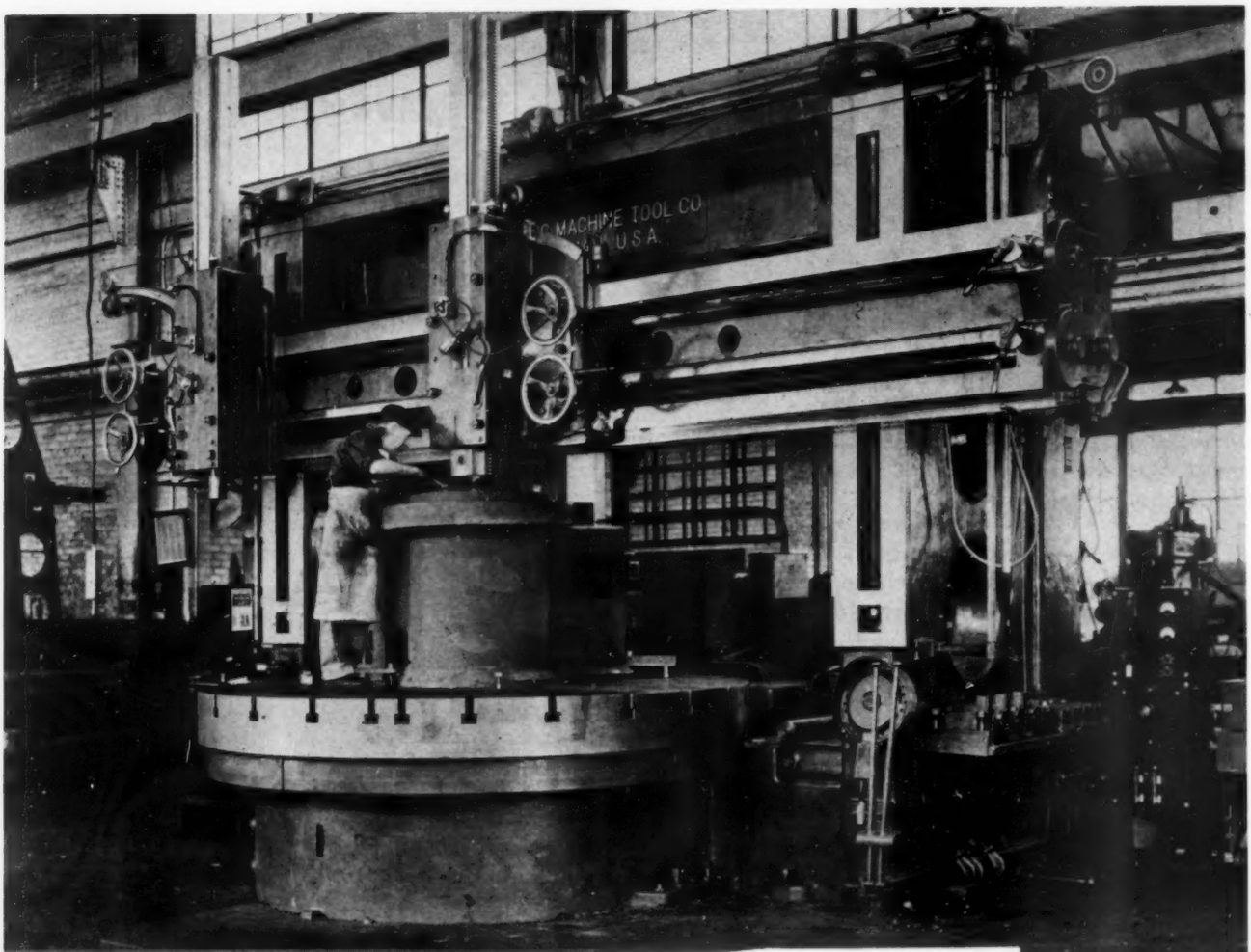
ORDNANCE • Typical gun barrels regularly honed in production include 50-caliber machine guns—20-millimeter cannon as well as other and larger calibers up to and including 16″ and 18″, and from 30 inches to 75 feet in length.

External honing of recoil piston rods generates accuracy within .0001″ to .0003″ and any desirable finish.

Internal honing of recoil cylinders generates round and straight accuracy within .0005″ to .0007″—and the exceptional "co-directional" draw-finish demanded by such service.



★★★A 10 FOOT KING BORING MACHINE *with 12 foot swing*



● The wide variety of work handled by a tool and die shop requires machine tools of the utmost versatility.

This king Heavy Duty Vertical Boring and Turning Machine is specifically designed to accommodate a wide range of boring and turning operations. The widened machine increases the normal swing of 10 feet to 12 feet—permitting it to take extra wide work as well as regular run of jobs similar to the one illustrated.

Push button control permits instant control of tools from normal working position and makes for greater production. For your Boring and Turning operations it will pay you to investigate King Vertical Boring and Turning Mills.

KING BUILDS

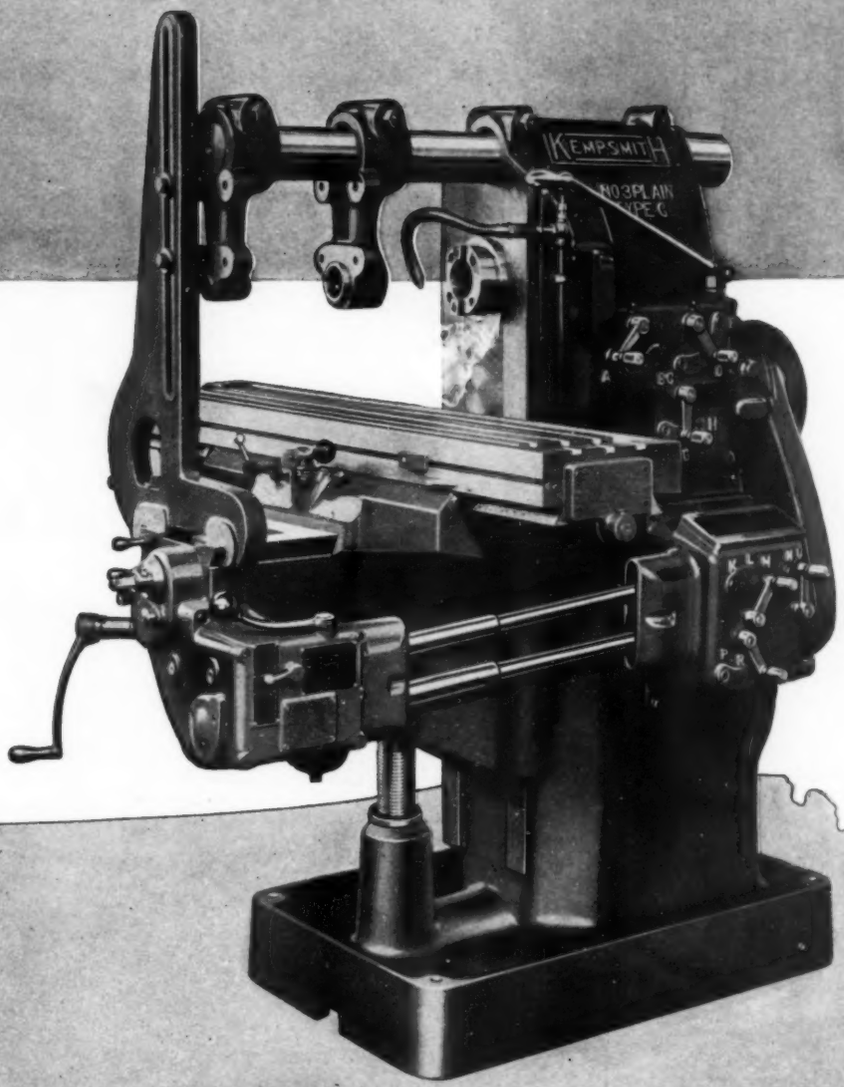
King Vertical Boring and Turning Machines are Built in single column types from 30" to 42" and double column up to 13 feet.

The KING MACHINE TOOL *Company*

BUILDERS OF VERTICAL BORING AND TURNING MACHINES EXCLUSIVELY

CINCINNATI, OHIO

KEMPSMITH *and* INDUSTRY
MUTUALLY MILLING *for* VICTORY



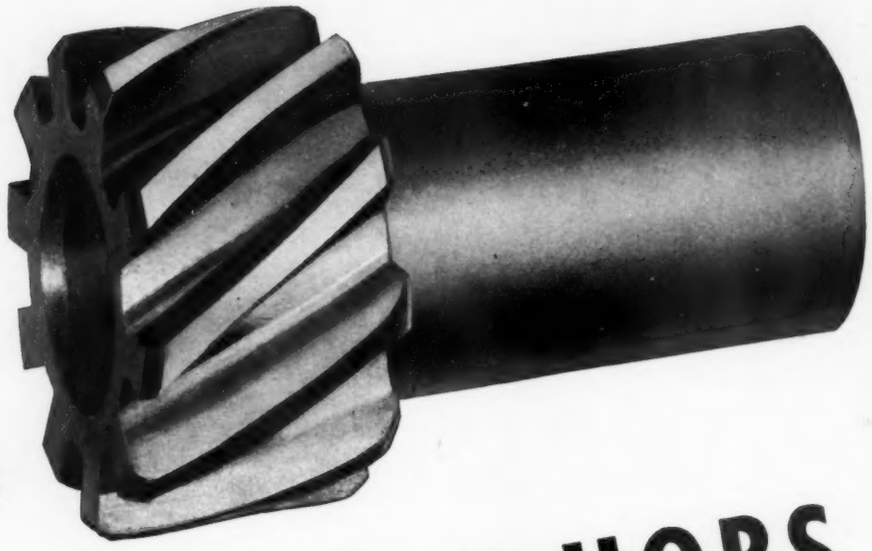
For Toolroom and general production work the new KEMPSMITH TYPE "G" All-Geared MILLER (plain or universal) has centralized control, 18 speeds and feeds (ball bearing speed, feed and spindle assemblies), Knee Gib, Unit Construction, Motor-in-Base . . . and other features that make it precise and reliable, economical in first cost, fast and efficient for PRODUCTION NOW!

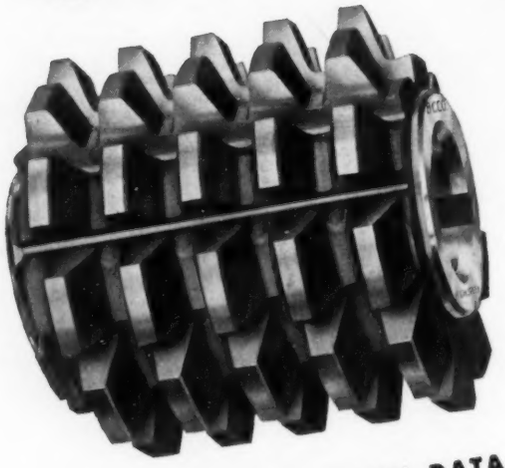
You AS USERS
and WE *as* PRODUCERS

have much in common today . . . 24-hour days, 168-hour weeks, speeding for speed, mutually resolving to do our part to shorten every KEMPSMITH that goes to help all out [illegible]

PRECISION
MILLING MACHINERY
Experience SINCE 1888
KEMPSMITH MACHINE CO.
MILWAUKEE • WISCONSIN

HOBBING DISTRIBUTOR GEARS . . . 30 PER HOUR





WITH B-C HOBS

1000 GEARS PER SHARPENING

THESE HEAT-TREATED cast iron distributor gears are required to have a backlash of not more than .003" when rolled with a full-sized master gear. B-C GROUND HOBS are used and the job is run on a battery of eight Barber-Colman standard No. 3 Hobbing Machines. Two operators, each handling four machines, produce about 1750 gears in each 8-hour shift, or over 5000 gears a day when working 24 hours. Each load, consisting of two gears placed end-to-end on an arbor, as shown in the illustration below, takes less than 4 minutes to cut, giving an average production of 30 pieces per machine per hour. Each hob is used in two positions, cutting 500 gears per position, or a total of 1000 pieces before being resharpened. This is a good demonstration of the productive capacity of B-C GROUND hobs and the whole job is a fine example of consistent accuracy under long-run commercial production conditions. B-C GROUND Hobs are turning in many similar performances and are recommended where PRODUCTION AND ACCURACY are both of prime importance.

SET-UP AND PRODUCTION DATA

Piece — Distributor Gear.

Material — Heat Treated Cast Iron, Brinell 269-302.

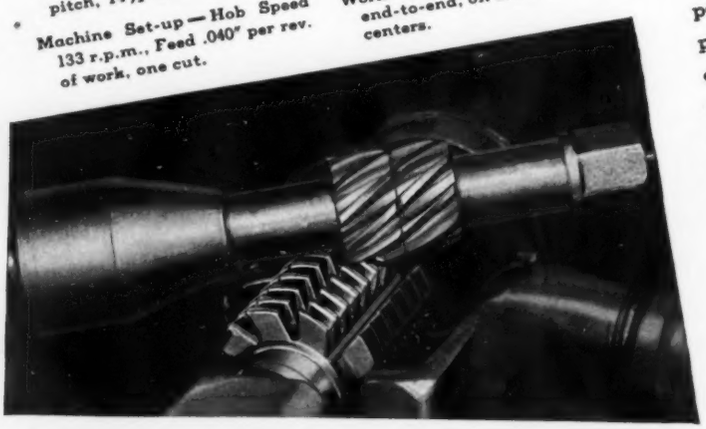
Dimensions of Gear — 1.124" O.D., ⅝" face, 10 teeth, 12 pitch, 14½° P.A., 30° helix.

Machine Set-up — Hob Speed 133 r.p.m., Feed .040" per rev. of work, one cut.

Production — 30 pieces per hour per machine, Four machines per operator.

Hob — B-C 2"x2"x¾" hole, single thread, GROUND. Hob is used in 2 positions, 500 pieces per position 1000 pieces per sharpening.

Work — Held 2 pieces per load end-to-end, on arbor between centers.



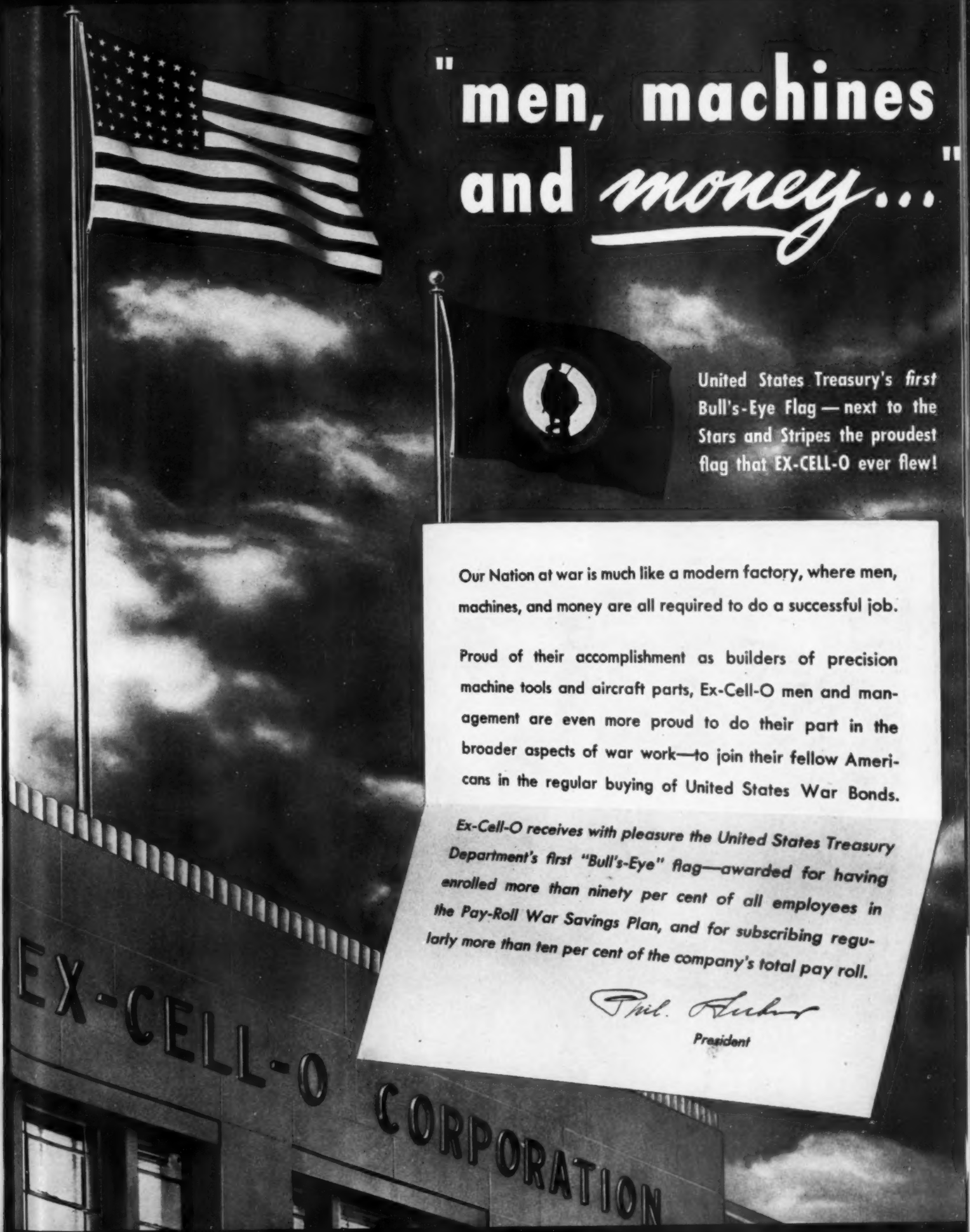
BARBER B-C COLMAN PRODUCTS

HOBS, HOBBING MACHINES, HOB SHARPENING MACHINES, REAMERS, REAMER SHARPENING MACHINES, MILLING CUTTERS, SPECIAL TOOLS

BARBER-COLMAN COMPANY

General Offices and Plant 201 Loomis Street, Rockford, Illinois, U. S. A.

"men, machines and *money*..."



United States Treasury's *first* Bull's-Eye Flag — next to the Stars and Stripes the proudest flag that EX-CELL-O ever flew!

Our Nation at war is much like a modern factory, where men, machines, and money are all required to do a successful job.

Proud of their accomplishment as builders of precision machine tools and aircraft parts, Ex-Cell-O men and management are even more proud to do their part in the broader aspects of war work—to join their fellow Americans in the regular buying of United States War Bonds.

Ex-Cell-O receives with pleasure the United States Treasury Department's first "Bull's-Eye" flag—awarded for having enrolled more than ninety per cent of all employees in the Pay-Roll War Savings Plan, and for subscribing regularly more than ten per cent of the company's total pay roll.

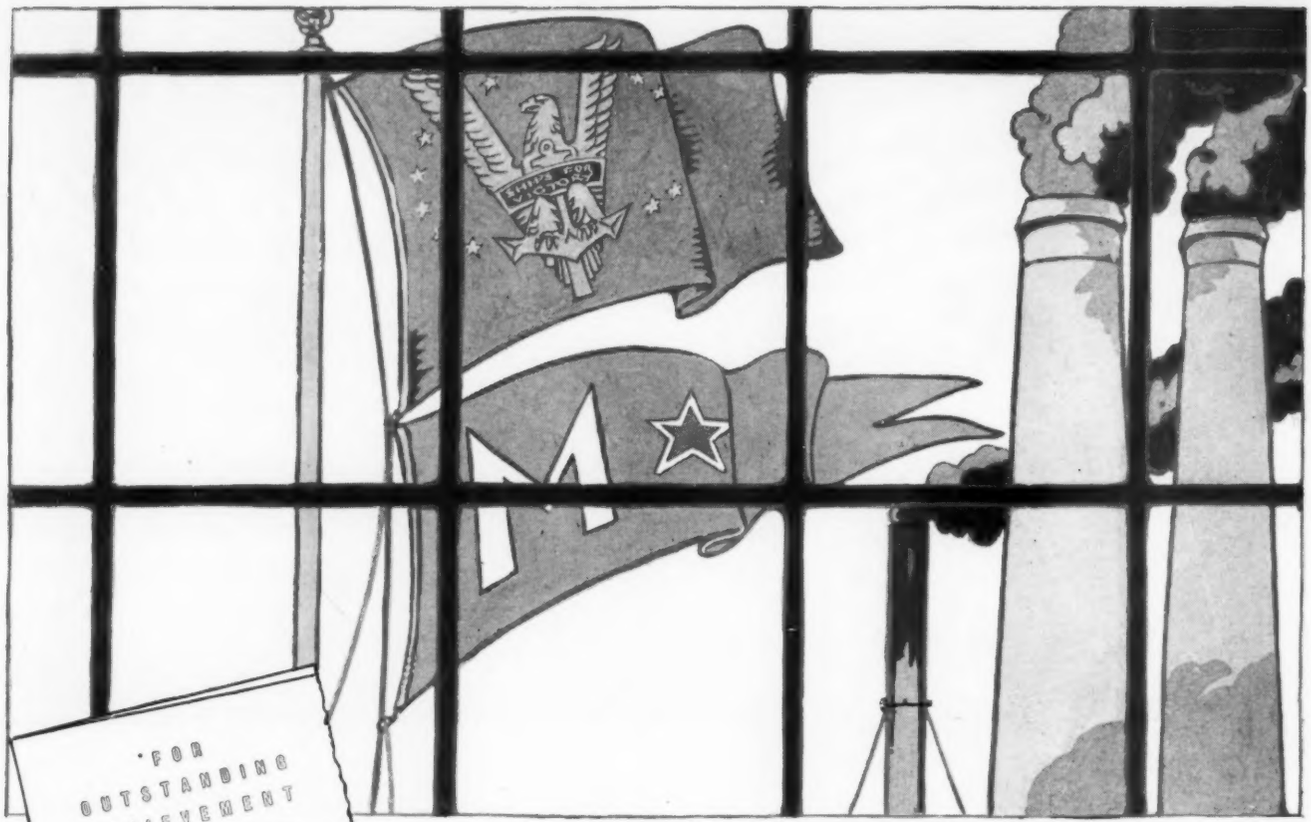
Phil. Huber

President

XLO

EX-CELL-O *means* PRECISION

EX-CELL-O MANUFACTURES PRECISION THREAD GRINDING, BORING AND LAPPING MACHINES, TOOL GRINDERS, HYDRAULIC POWER UNITS, GRINDING SPINDLES, BROACHES, CUTTING TOOLS, DIESEL FUEL INJECTION EQUIPMENT, R. R. PINS AND BUSHINGS, DRILL JIG BUSHINGS, PARTS . . . EX-CELL-O CORPORATION, DETROIT, MICHIGAN



– *and we shall do* BETTER

In the all-out effort, we are proud to say that our men and we have been awarded the Maritime "M" Burgee-for Merit-the first industrial plant to be so honored.

GENERAL MACHINERY CORPORATION

HAMILTON, OHIO

THE NILES TOOL WORKS CO.

THE HOOVEN, OWENS, RENTSCHLER CO.

GENERAL MACHINERY ORDNANCE CORPORATION

UNION

TOOL ECONOMY IS IMPORTANT TODAY

Present conditions make it vitally important that maximum service be obtained from every small tool. One of the first steps toward tool economy is to choose tools that are known for their ruggedness and longer lasting accuracy.

Choose UNION Tools—treat them well—and you will see the results of your economy in the longer accurate service and uninterrupted production you get from every tool bearing the UNION name.

Union Butterfield Card

Divisions of the UNION TWIST DRILL CO.

UNION TWIST DRILL CO.
ATHOL, MASS.

S. W. Card Mfg. Co. Div., Mansfield, Mass.
Butterfield Div., Derby Line, Vt.
Butterfield Div., Rock Island, Quebec.

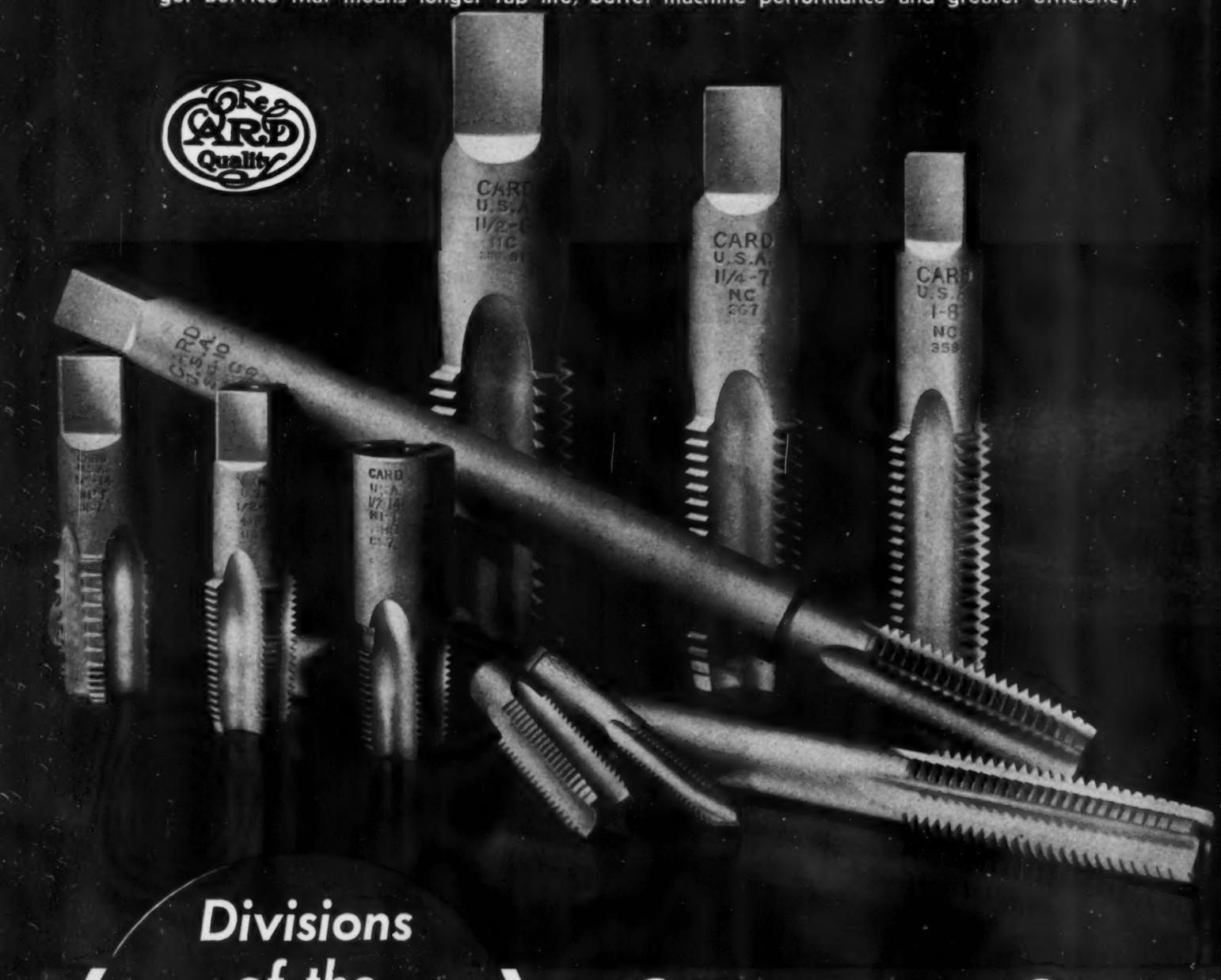
STORES

New York: 61 Reade St.
Chicago: 11 So. Clinton St.
Detroit: 6540 Antoine St.
San Francisco: 121 Second St.
Los Angeles: 524 E. Fourth St.
Seattle: 568 First Ave., South

CARD

Get better tapping results on war production jobs! Have the Card organization show you how to get the last ounce of value from every tap you use. We can give you reliable information on every phase of thread production—preliminary drilling and reaming, correct lubrication, correct tap grinding . . . You get more than a supply of tools when you order Card Taps. You get Service that means longer tap life, better machine performance and greater efficiency.

The CARD Quality



Divisions of the UNION TWIST DRILL CO.

Union Butt e

S. W. CARD MFG. CO.
MANSFIELD, MASS.

STORES

New York: 61 Reade St.
Chicago: 11 So. Clinton St.
Detroit: 6540 Antoine St.
San Francisco: 121 Second St.
Los Angeles: 524 E. Fourth St.
Seattle: 568 First Ave., South

Reamers that are **right**—for jobs that demand the utmost in precision . . . for trouble-free, tool-saving performance under heavy high production demands . . . for results that satisfy in every material, all types of work.

Choose Butterfields, and let this one great name be your guide to the right tool for every reaming job.

»

BUTTERFIELD DIVISION
DERBY LINE, VERMONT
ROCK ISLAND, QUEBEC

erfield Card

BUTTERFIELD DIVISION
DERBY LINE, VT. **ROCK ISLAND, QUE.**

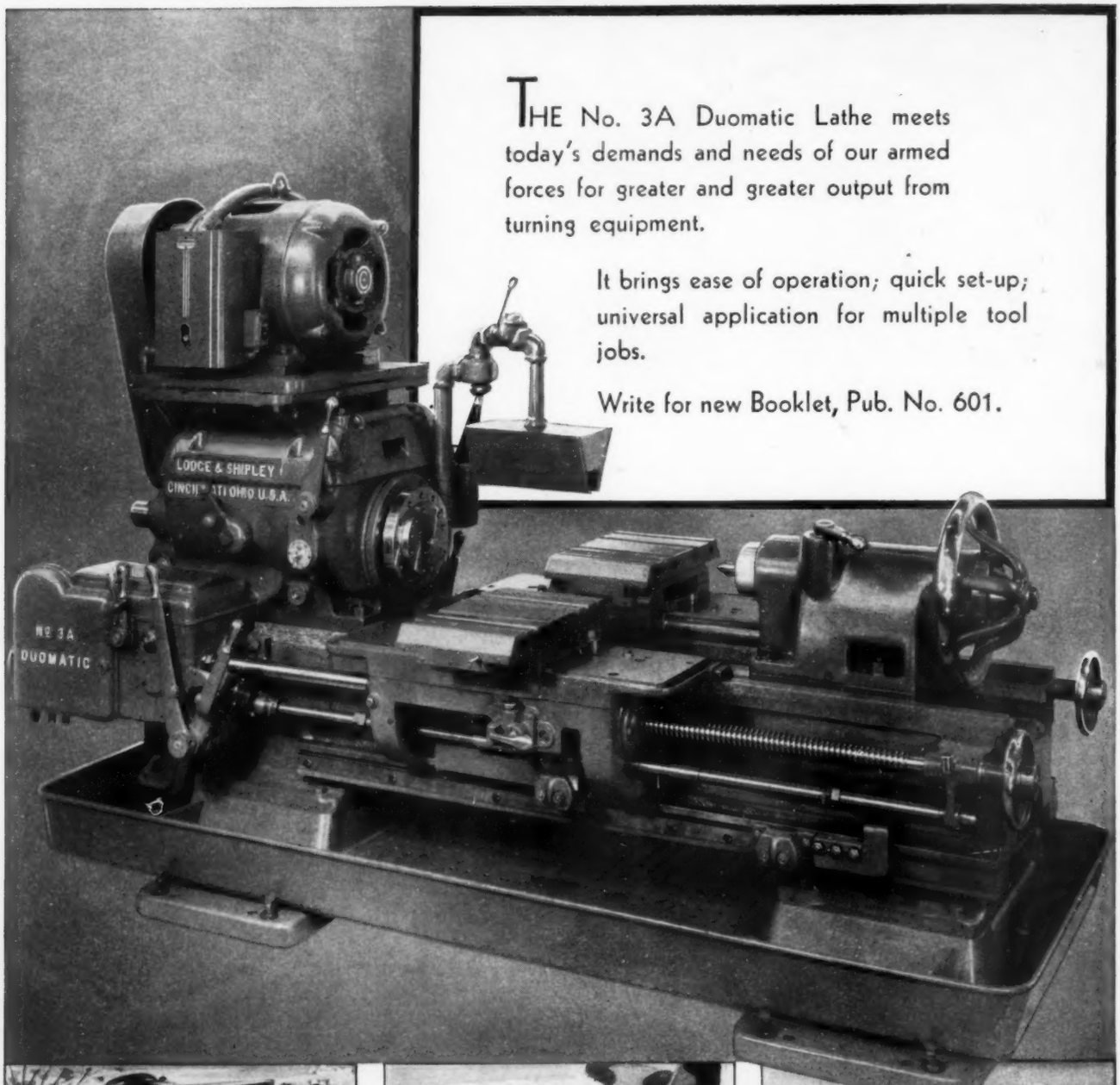
STORES: New York, 61 Reade St. Chicago, 11 So. Clinton St. Cleveland, Hal W. Reynolds, 3346 Superior Ave. Detroit, 6540 Antoine St. Los Angeles, 524 E. Fourth St. Toronto, 208 King St., West. Montreal, 111 St. Paul St., West. Winnipeg, 403 Travellers Bldg. Vancouver, 327 Shelly Bldg. Agents for Great Britain—Charles Churchill & Co., Ltd., 27-34 Walnut Tree Walk, Kennington, London, S. E. 11, England. Branches at Birmingham, Manchester, Glasgow, Newcastle-on-Tyne and Bristol.

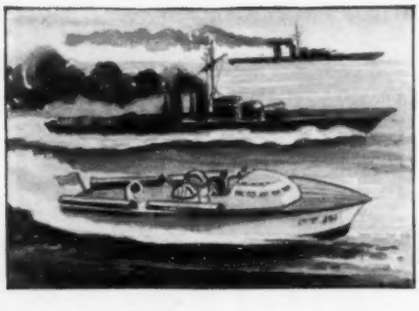
Divisions of the
UNION TWIST DRILL CO.

THE No. 3A Duomatic Lathe meets today's demands and needs of our armed forces for greater and greater output from turning equipment.

It brings ease of operation; quick set-up; universal application for multiple tool jobs.

Write for new Booklet, Pub. No. 601.





THE LODGE & SHIPLEY MACHINE TOOL CO.

CINCINNATI, OHIO

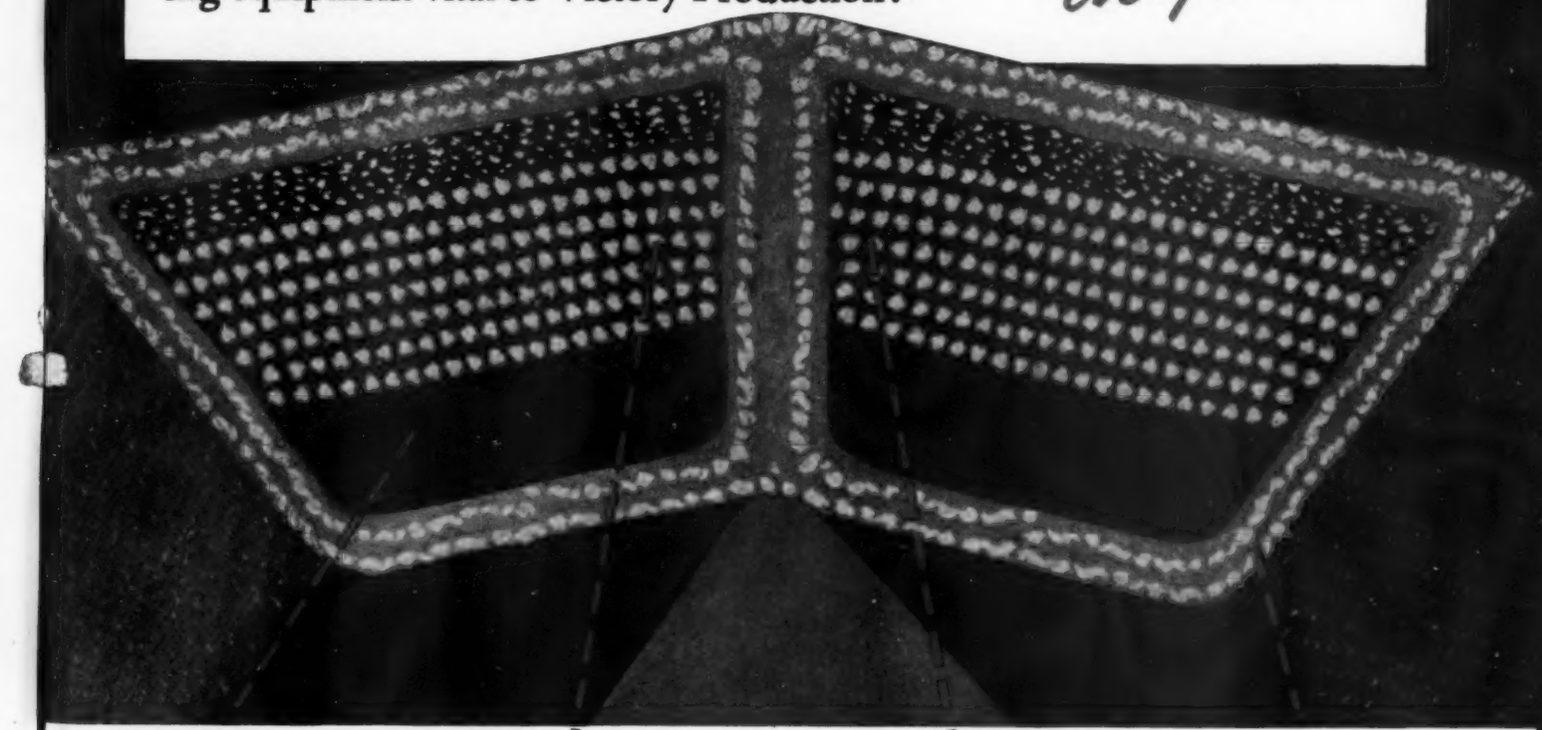
since 1892

ENGINE TOOL ROOM AUTOMATIC LATHES

Open Book on WARTIME CARE OF V-Belts

Texrope Super-7's new Design-Against-Wear points to ways *You* can make V-Belts last longer — whatever brand you now use — saving equipment vital to Victory Production!

V-Day needs every V-Belt



Design-against-heat . . .

Texrope Super-7's revolutionary new shock-absorbing cushion contributes to cool operation.

You can fight friction and heat by preventing misalignment. When present, it subjects V-belts to rubbing on the side . . . builds up heat. So keep grooves in line — shafts parallel.

Design-against-stretch

Texrope Super-7's 50% stronger cords produced by the new Flexon process combat stretching — plus the slip and burning that might result.

You can fight stretch — no matter what make of V-belts you are using — by promptly taking up any extra slack that may develop. Inspect drives regularly!

Design-against-breaks

The 20% more cords built into the new Texrope Super-7 combat strains.

You can fight breaks by requiring that your V-belts never be pried into grooves — nor rolled from one groove to the next. Before installing or removing V-belts, the motor always should be moved forward.

Design-against-dirt . . .

The new Duplex-Sealed cover safeguards Texrope Super-7 against grit, grime and moisture.

You can fight dirt by seeing that your V-belts are wiped off as frequently as conditions require. Never permit dressings to be used on your V-belts. Remember, oil is poison to rubber!

A 1542

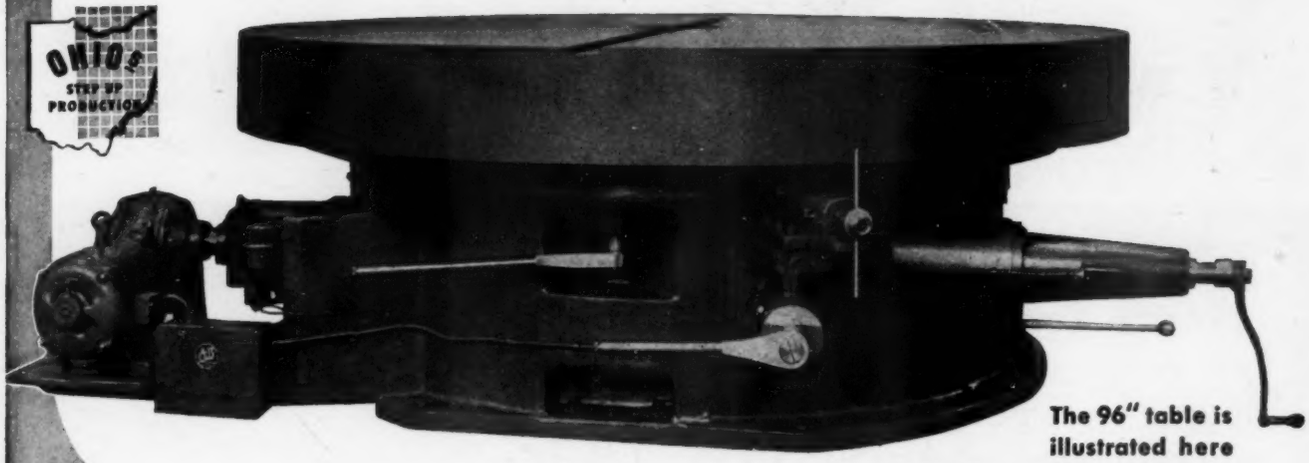
ALLIS-CHALMERS

WE WORK FOR VICTORY — WE PLAN FOR PEACE

TEXROPE* SUPER-7 V-BELTS

*Trade mark registered U. S. Patent Office. Texrope Super-7 V-Belts are the result of the cooperative research and design genius of two great companies — Allis-Chalmers and B. F. Goodrich — and are sold exclusively by Allis-Chalmers. Available in all sizes..... ½ h.p. to 2,000 h.p.

OHIO *Revolving* TABLES



The 96" table is illustrated here

Graduated accurately in ½ degrees. Overall height—36". Thickness of table top—14". Anti-friction raising device for rapid and easy revolving. Pressure lubrication. Power rapid traverse. Four precision dial or index pin positions for indexing. Wgt.—18,000 lbs.

Round or square, 24" to 96", many combinations

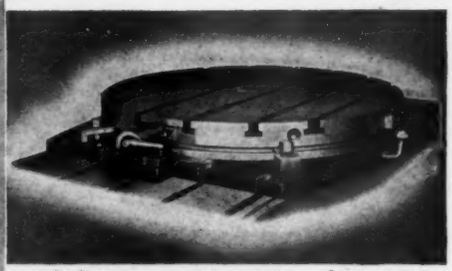
The 96" Ohio Revolving Table is designed primarily for use with floor type horizontal boring mills, but can be used with other types of machine tools. Intended for extra heavy duty service and large jobs, it carries a load of 20,000 to 25,000 pounds with ease. Features:

Equipped with anti-friction raising device for raising top and easy, rapid revolving. Large-diameter anti-friction thrust bearing supports table when raised from its bearing. Can be furnished with or without power rapid traverse.

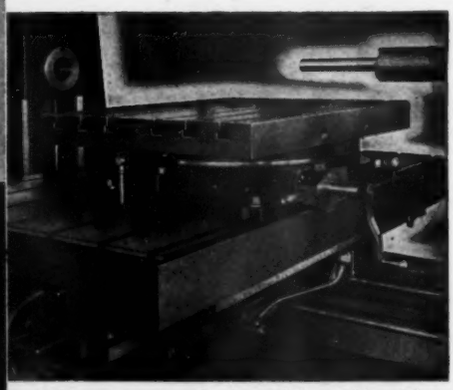
Table unit is designed for mounting one or more jobs. By using one or more machine tools, several machining operations can be performed simultaneously. For example, a horizontal drill can perform drilling and tapping operations on one piece, while a horizontal boring mill can do boring and milling work on another piece. Other positions can be used for loading.

Unit can be mounted on bed plate or individual foundation. Design makes operation possible when set in a pit below floor surface.

THE OHIO MACHINE TOOL COMPANY, KENTON, OHIO



48" diameter revolving table on base plate with anti-friction raising device and index pin with four stops.



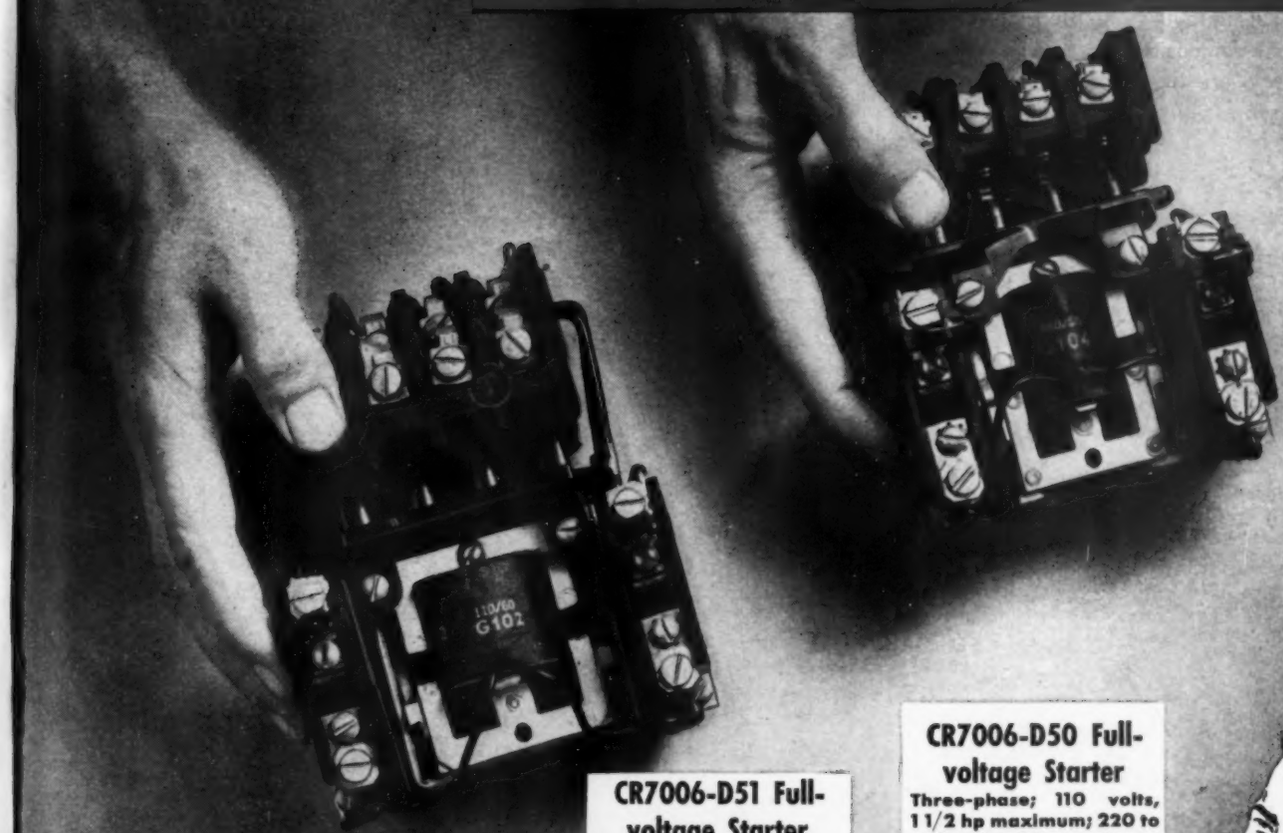
48" square worm feed revolving table with anti-friction raising device and index pin and four stops.

Ohio Revolving Tables are the expression of over 50 years' machine tool manufacturing experience. They are high grade precision units, accurately graduated in ½ degrees. They can be supplied with indexing pins with any number of indexing positions or precision indexing units consisting of precision dial indicators and adjustable stops. You can arrange them to suit all types of standard horizontal or vertical boring machines.

OHIO DREADNAUGHT

HORIZONTAL BORING, DRILLING AND MILLING MACHINES • SHAPERS • PLANERS

THESE MAGNETIC STARTERS ARE AVAILABLE FOR *PROMPT DELIVERY* FOR WAR WORK

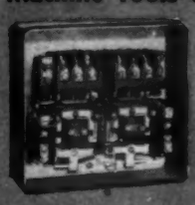


CR7006-D51 Full-voltage Starter
Three-phase; 110 volts, 3 hp maximum; 220 volts, 5 hp maximum; 440 to 600 volts, 7 1/2 hp maximum

CR7006-D50 Full-voltage Starter
Three-phase; 110 volts, 1 1/2 hp maximum; 220 to 600 volts, 2 hp maximum

Starters for Machine Tools and General-purpose Applications

Enclosed CR7006-D50 Starter
Three phase; 110 volts, 1½ hp maximum; 220 to 600 volts, 2 hp maximum.



CR7009-B31JD Magnetic Reversing Starter
Three-phase; 110 volts, 3 hp maximum; 220 volts, 5 hp maximum; 440 to 600 volts, 7½ hp maximum.

Enclosed CR7006-D51 Starter with Push-button in Case
Three-phase; 110 volts, 3 hp maximum; 220 volts, 5 hp maximum; 440 to 600 volts, 7½ hp maximum.

CR2943 Push-button Stations
These accessory stations are available for either START-STOP or FORWARD-REVERSE-STOP service.

JUST pick up your phone and call the nearest G-E office. Tell us your priority rating and the type of starter you want. In most cases, we'll be able to have your starter, or starters, on the way to you before the end of the day.

Centrally located warehouses which carry an ample stock of the popular sizes and types of magnetic starters make this kind of service possible.

When you need motor control in a hurry, call your local G-E salesman. In most cases he will have just what you need in stock. *General Electric, Schenectady, N. Y.*

The Navy "E", for Excellence, has been awarded to 92,780 General Electric employees in five plants manufacturing naval equipment.

GENERAL ELECTRIC

676-42-8490

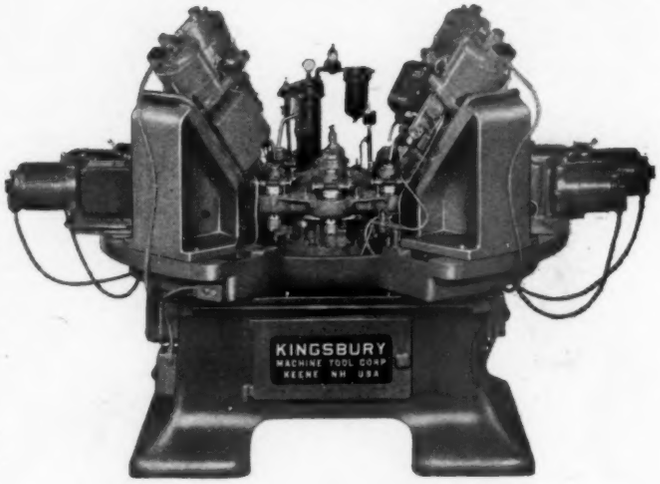
FLEXIMATIC

Demonstrates its Speed and Accuracy on Fuse Part Production

Drilling, counterboring and tapping brass fuse part components—doing the entire job in a single chucking of the work—producing 500 completed parts per hour! Jobs like this, that demonstrate FLEXIMATIC speed, simplicity and accuracy, are the reason why FLEXIMATICS are so widely chosen for intricate operations on munitions parts.

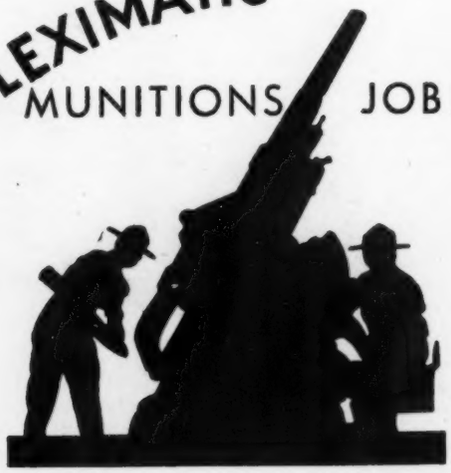
Kingsbury FLEXIMATICS are made up of standard units mounted on one of several types of standard bases. This method greatly lowers the cost of special machine construction and, in addition, permits changes to be readily made to meet changes in production. In the FLEXIMATIC illustrated, individual work holding fixtures in the turret are automatically indexed during the indexing of the main turret, thus presenting the part in various positions at the work stations so that all the operations are performed in a single chucking.

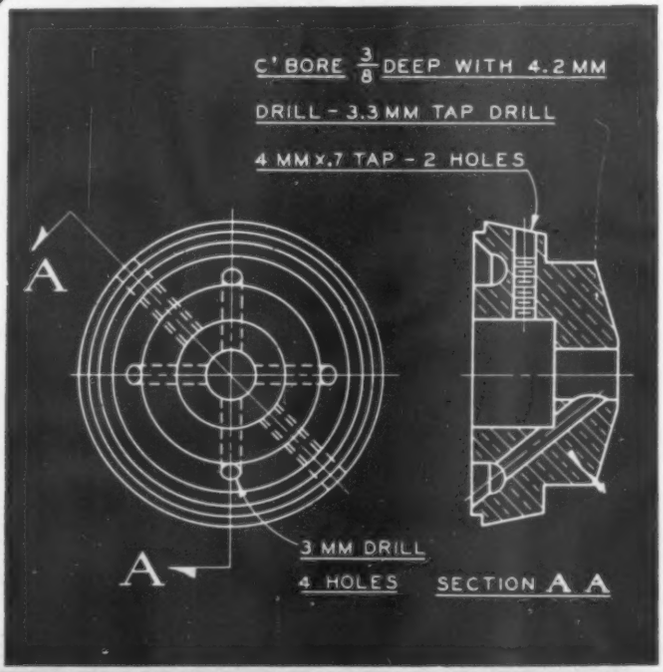
To meet the exacting standards of accuracy and the imperative need for speed in munitions production choose FLEXIMATICS by Kingsbury!



by KINGSBURY

THIS IS A FLEXIMATIC MUNITIONS JOB!





KINGSBURY MACHINE TOOL CORPORATION

KEENE NEW HAMPSHIRE U S A

MID-WEST REDUCED THIS GUN MAKER'S HONING TIME BY 83 PERCENT!

How Excessive is Your Honing Time?

The X Manufacturing Company, one of the largest gun builders in the United States, ran smack into serious trouble in the honing of their three-inch and five-inch gun barrels. The honing was being done in two operations—roughing and finishing—during which approximately .011" of stock was being removed. The trouble lay in excessive heat being generated within the barrels. The heat was so terrific company engineers had to pour oil on the outside of the barrels throughout the honing operation. Notwithstanding this, the heat caused considerable distortion and many of the barrels had to be straightened and rehoned.

Furthermore, the heat limited the honing machine to a steady run of only 15 minutes, after which the barrels had to cool for two hours before inspectors could star gauge the gun. Average time required to hone a barrel ranged from 4½ to 5 hours.

A Mid-West engineer was invited in. He found the hones the company was using were too hard. They were "loading up," chipping along the edges, generating excessive heat and creating an altogether unsatisfactory finish. Following a few experimental runs with other stones he recommended the MID-WEST 180 52X hone for the rougher and the MID-WEST 500 38X hone for the finisher. These stones were adopted with this result:

- ✔ THE OIL COOLING TREATMENT HAS BEEN ABANDONED!
- ✔ INSPECTORS CAN STAR GAUGE IMMEDIATELY AFTER HONING!
- ✔ THE SURFACE FINISH HAS BEEN GREATLY IMPROVED!
- ✔ AVERAGE HONING TIME HAS BEEN REDUCED FROM 4½ TO 5 HOURS TO APPROXIMATELY 50 MINUTES PER BARREL!

That is but one instance in which MID-WEST Micro Bond honing stones have helped to save time, material and money and increase production — all vital contributions to our war effort. There are many others. Why not ask our engineers—located in most large cities throughout the United States—to tell you about them? Ask them about Micro Bond, the remarkable new abrasive developed by MID-WEST that has "given a new prod to production." Or, mail in the coupon printed herewith. Let us help YOU with YOUR honing problem.

MID-WEST ABRASIVE COMPANY

Manufacturers of DEPENDABLE Abrasives

1960 E. MILWAUKEE AVENUE — DETROIT, MICHIGAN

Mid-West

- ★ *Honing Stones*
- ★ *Superfinishing Stones*
- ★ *Grinding Wheels*
- ★ *Emery Cloth*
- ★ *Sandpaper*

Mid-West Abrasive Company,
1960 E. Milwaukee Avenue,
Detroit, Michigan

Gentlemen: Please send me additional information on Mid-West Micro Bond honing and superfinishing stones.

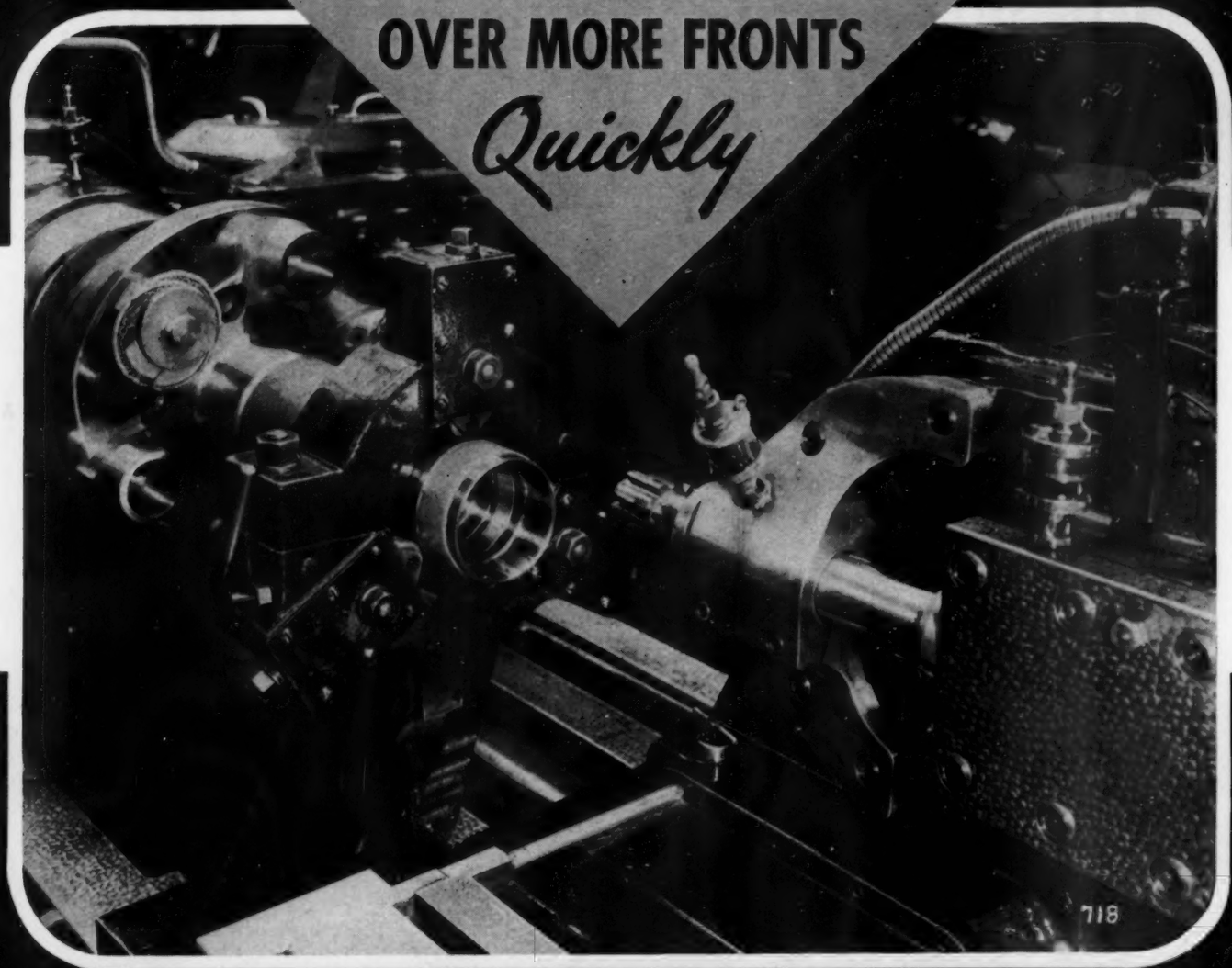
*Name*_____

*Company*_____

*Address*_____

*City*_____ *State*_____

TO PUT MORE PLANES OVER MORE FRONTS *Quickly*



LEES-BRADNER *Model H-T* THREAD MILLERS

The number of Lees-Bradner Thread Millers operating in the aircraft industry is conclusive evidence of their ability to produce precision threads, cleanly, at unusually high production rates. Here an H-T Thread Miller is milling an internal thread on the propeller shaft of a radial engine for a prominent builder of aircraft engines.

The LEES-BRADNER *Company*

CLEVELAND, OHIO, U.S.A.

PHOTO BY U. S. ARMY SIGNAL CORPS

BIG TIME SAVINGS ARE BEING MADE *by...*

P&J

AUTOMATIC CHUCKING EQUIPMENT

in turning out war work

Tooled for speed and maximum productivity, Potter & Johnston machines are turning out duplicate parts to the closest limits of accuracy for a wide variety of vitally needed war implements.

Typical armament products on which P&J equipment is making big savings in production time include parts for airplanes, airplane engines, tanks, Borfors guns, 90 mm anti-aircraft guns, machine guns, adaptors for shells, and the American Oerlikon gun.

Potter & Johnston engineers are constantly thinking in terms of "more pieces in less time' with fewer machine operators. In many P&J-equipped arsenals of democracy, one machine attendant is easily able to handle two or more P&J machines, thereby releasing skilled help for other productive work.

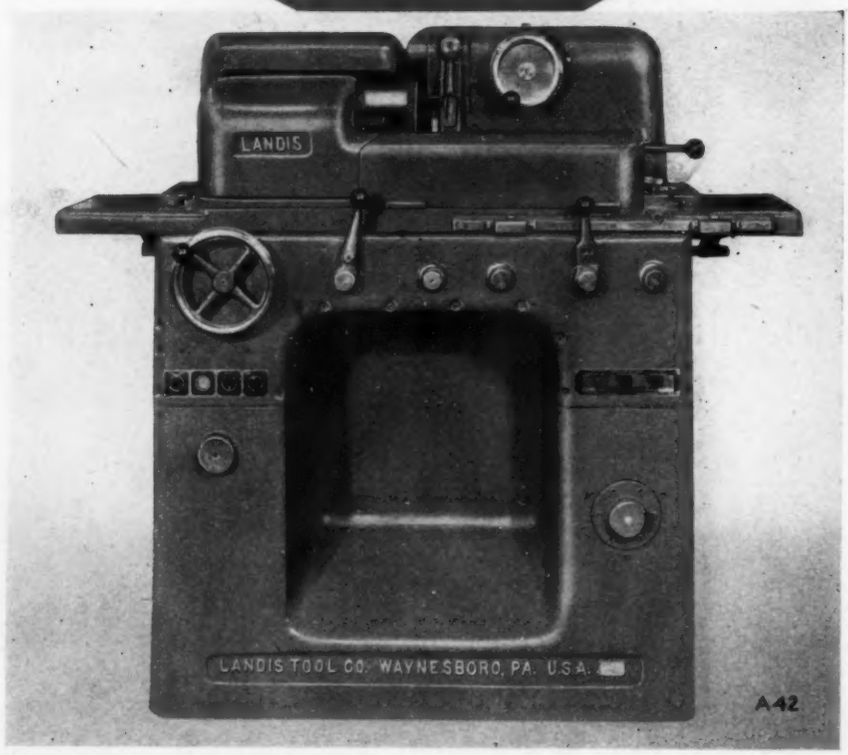
THE POTTER & JOHNSTON MACHINE CO.

Pawtucket, R. I.

TO FINISH THE JOB QUICKER . . .

THIS LANDIS PERFORMS

4300 OPERATIONS IN 10½ HOURS



PRECISION LANDIS GRINDERS

Unusual Performance As Usual

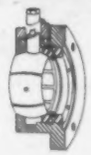
Are top manufacturers working at top speed? Just ask any of them and the answer will be a loud "YES".

If you ask a certain one, he will in addition undoubtedly point out the manner in which Landis 4" Type H Plain Hydraulic Grinders are helping meet the abnormal demands for his product. One of these machines is actually performing 4300 operations in 10½ hours. This, we submit, is a quite unusual record.

No grinder not properly designed and skillfully handled could even approach such productiveness. The Landis Type H has what it takes, as evidenced by performance in this plant and in many others. Are you certain that you have what it takes in your Grinding Department to turn out the smaller parts at the rate demanded today? If not, try the Type H.

LANDIS TOOL CO. WAYNESBORO, PENNSYLVANIA.

VARIABLE VOLTAGE HEADSTOCK.



MICROSPHERE WHEEL SPINDLE BEARINGS.

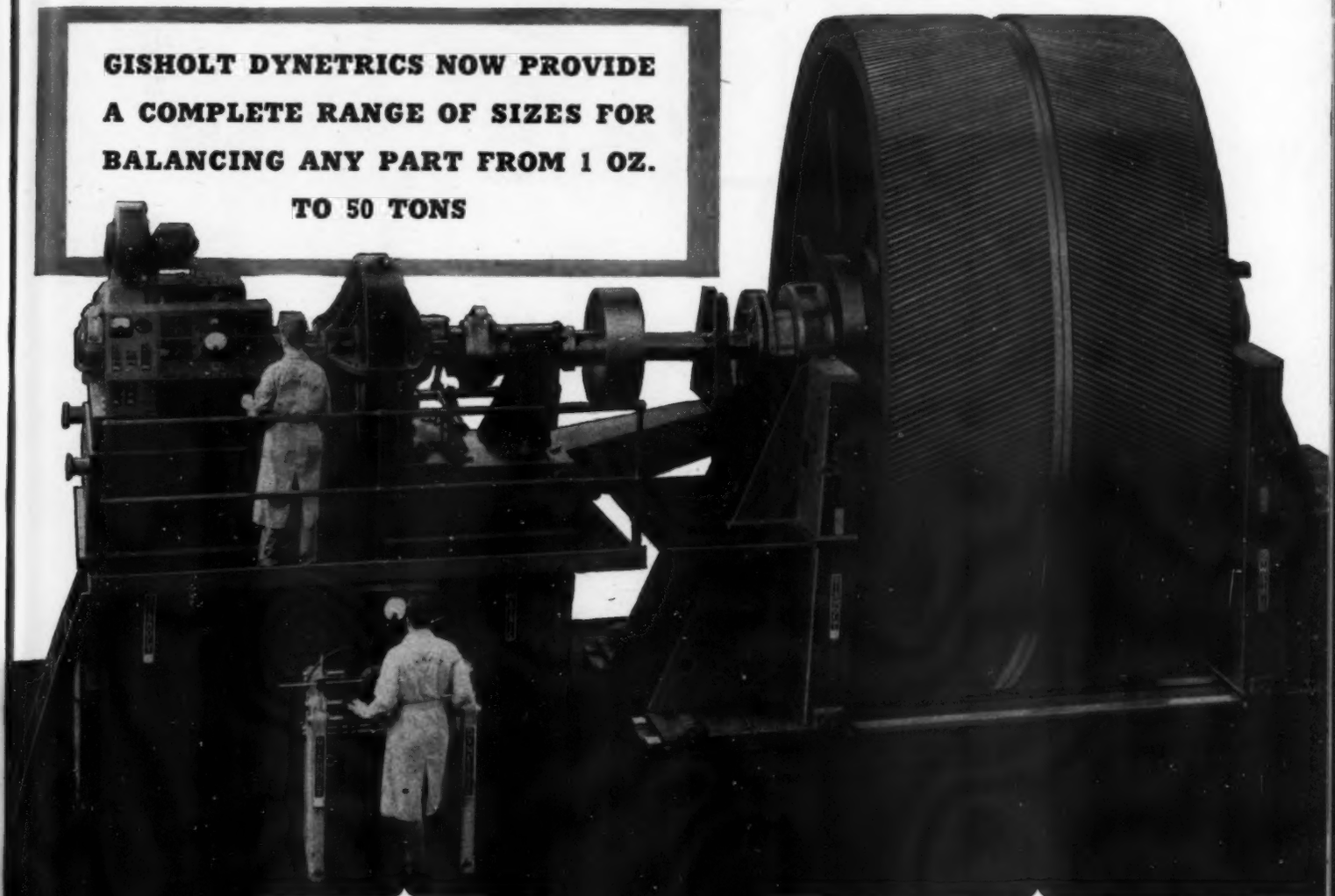
MICROMETER WHEEL FEED.

400

IF IT ROTATES

IT CAN BE BALANCED!

GISHOLT DYNETRICS NOW PROVIDE A COMPLETE RANGE OF SIZES FOR BALANCING ANY PART FROM 1 OZ. TO 50 TONS



THE TYPE S DYNETRIC the smallest of the entire line, has now been perfected to the point where it performs balancing operations on parts as small as 1 ounce in weight.

THE NEW FLOOR TYPE DYNETRIC largest of its kind, is shown here balancing a huge marine reduction gear. This massive herringbone has a 16' 8" diameter, face width of 7' 4", and total weight of 100,000 pounds.

The new Floor Type Dynetric is built to accommodate parts up to 240 inches in length or requiring a swing of 200". Typical of Gisholt research and development, it is a noteworthy contribution to America's war production effort.

The Gisholt principle of Dynetric Balancing is the proved and practical means of reducing vibration and excessive wear to insure more efficient performance and longer life.

These newest developments extend its advantages in both directions—down to parts as small as 1 oz. in weight and upward to those weighing as much as 50 tons. Whatever your problem in correcting for true static and dynamic balance, Gisholt Dynetrics answer it. Full information on request.

GISHOLT MACHINE COMPANY, 1201 E. Washington Ave., Madison, Wis.

LOOK AHEAD • KEEP AHEAD • WITH GISHOLT IMPROVEMENTS

TURRET LATHES • AUTOMATIC LATHES • BALANCING MACHINES

GISHOLT

ONE OF A BATTERY OF FOSDICK HIGH SPEED SENSITIVE DRILLS SPEEDING TOOLS AND DIES TO WAR INDUSTRIES

• Time is the major factor in our present War effort. Production 24 hours a day in Tool & Die Shops is speeding high production Tools, Jigs and Fixtures to arms plants, navy yards, munitions factories in ever increasing numbers.

Illustrated is one of a battery of Fosdick High Speed Drills all operating full time in a midwestern Tool & Die Shop in an all-out effort to keep us out in front of production demands.

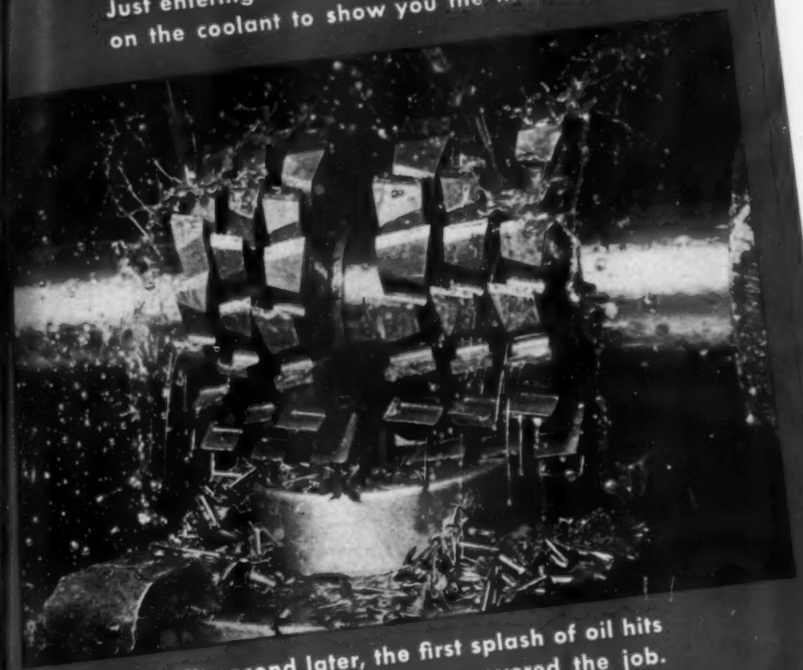
Likewise in hundreds of other plants Fosdick High Speed Drills are drilling, reaming, counterboring, facing and performing numerous other operations quickly —accurately—at low cost.

A wide range of spindle speeds, heat treated gears of nickel Molybdenum steel, sturdy table with long support on pedestal, centralized controls are but a few of the construction features that keep Fosdick H.S. Drills on the job 24 hours a day 7 days a week.

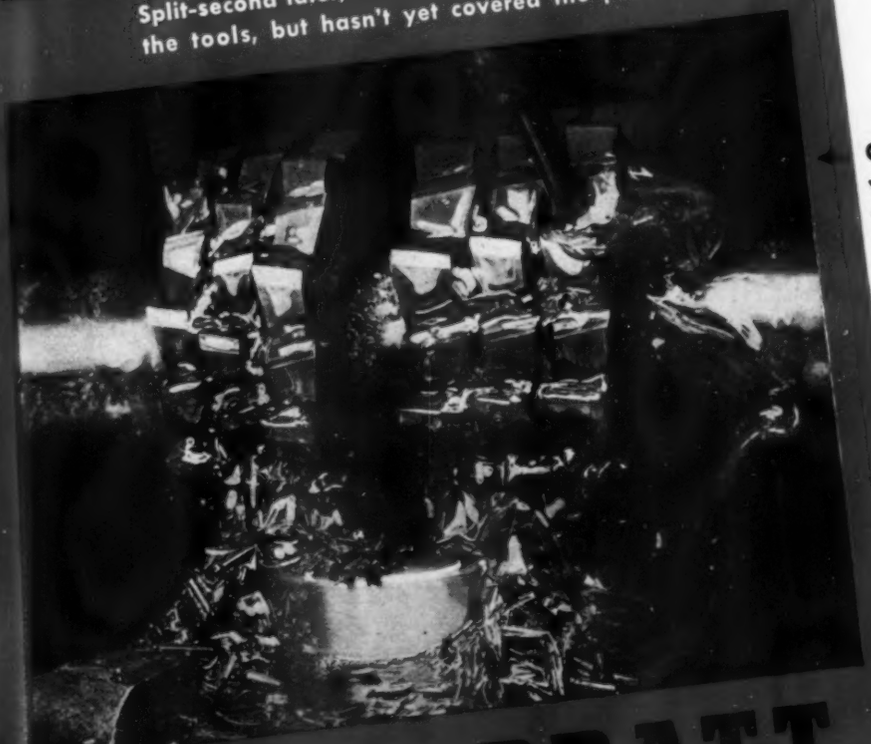
They're reasons why you should make Fosdick High Speed Drills your choice. Built in sizes up to 1¼" capacity. Bulletin H.S.A. Fosdick Drills gives complete details. Write for your copy today.

FOSDICK MACHINE TOOL COMPANY
CINCINNATI ··· OHIO

Just entering the work. We delayed turning on the coolant to show you the first chips.



Split-second later, the first splash of oil hits the tools, but hasn't yet covered the job.



P&W Photos — Unretouched

Frozen Action P&W PHOTOS 1/100,000 SEC.

Gangway, Goering

Here Comes Our Gang!

HERE'S a blitz-shot series of photos that would give any metal working German a sleepless night.

This is a gang of six Pratt & Whitney staggered-tooth milling cutters, mounted on one arbor and really putting the bite on a chunk of war production work.

Ripping off the chips, yes, but *accurately*. Like all P&W small tools, these cutters were shaped, hardened, sharpened, and selected for their jobs with as much care as the R.A.F. puts into a raid.

Wherever the goods of war are a-building in America, there are P&W tools at work . . . and that likely includes *your* plant too, Mr. Reader. So get this: *don't spare the pressure* . . . your P&W tools can take it. Keep 'em cutting; there are more where they came from. We're making them, and you're working them, twenty-four hours a day.

Coolant streams not yet adjusted, but we're wheeling! Cutters walk right through the work . . . will be ready to tackle the next piece in jig-time.

PRATT & WHITNEY

Division Niles-Bement-Pond Company

WEST HARTFORD, CONNECTICUT

Le Blond Lathes in War or Peace . . .

are dedicated to low cost, high speed, precision turning. Just as highly efficient LeBlond Lathes are now helping speed our victory, so also will they aid in the speedy production of more goods for more people at less cost in the peace that will follow.

THE R. K. LeBLOND MACHINE TOOL CO., CINCINNATI, OHIO

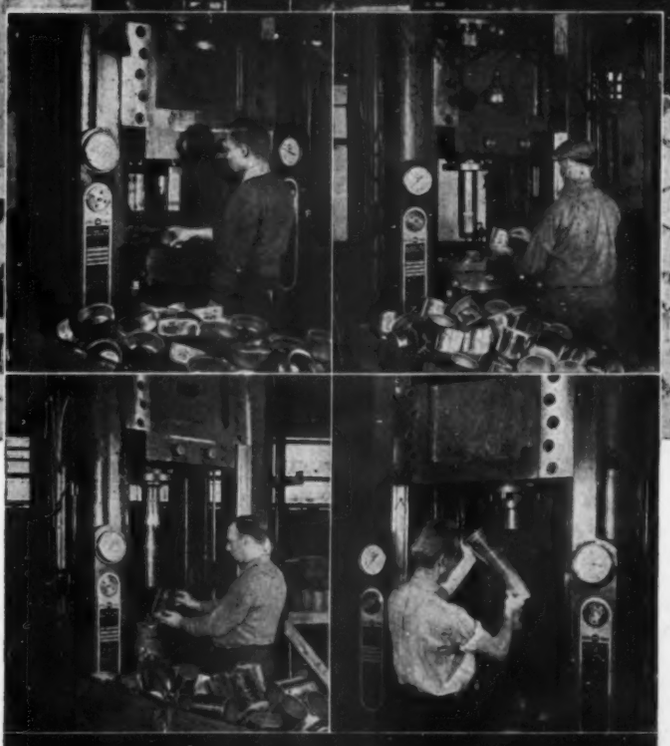
Chicago:
20 N. Wacker Dr.
STA 5561

New York:
103 Lafayette St.
Canal 6-5281

Largest Manufacturer of a Complete Line of Lathes

Steel Cartridge Case Production Pioneered with HPM FASTRAVERSE PRESSES

Experiments made with standard HPM brass cartridge case drawing presses have proved so satisfactory that HPM FASTRAVERSE presses are now considered the production standard for both brass and steel cases.



HPM self-contained hydraulic presses are entirely the product of HPM engineering and design. The press and its "closed circuit" operating system, including the radial, piston type, pressure generator, are built in HPM plants. ● For maximum cartridge case production, operating economy and reliability, specify the HPM "all hydraulic" line of FASTRAVERSE presses. Capitalize on HPM's pioneering experience. Write for complete details.

THE HYDRAULIC PRESS MFG. COMPANY

Mount Gilead, Ohio, U. S. A.

District Sales Offices: New York, Syracuse, Detroit and Chicago

Representatives in Principal Cities

The production of cartridge cases involves a series of progressive redrawing operations, from flat disc to final length and section. Cases are then headed and tapered. Several of these operations are illustrated above. Major illustration (at left) is the final drawing press. Notice the hydraulic pump and motor drive are mounted overhead, out of the way. Wire tube conveyor at rear of press permits cases to be transferred automatically from press to washing tank.

BEHIND THE SCENES With DoAll

Metal and alloy parts cut on the DoAll Contour Machine are so smooth and clean that they are all ready for use *without further machining* or finishing. Think of the time this saves!

Then, to add to its versatility, DoAll production engineers have developed valuable *plus* equipment to handle all kinds of heavy work and jobs of irregular shapes—hydraulic work feeds, rip fences, ball-bearing work slides, work holders and guides, supports for long, heavy parts, mitering attachments for cutting tubing and channel stock at any angle, circle cutting fixtures, illuminating magnifying glasses, and others.

AIRPLANE AMBULANCES

The U. S. Air Corps has a fleet of mobile machine shops for repairing damaged planes right on the spot—the shop goes to the plane. Each "ambulance" contains a DoAll Machine as part of its essential equipment.

FOR THAT "BETWEEN MEALS" SLUMP

For the past two years, Continental has been distributing free vitamin tablets regularly to employees and since early this spring, they have also provided free drinks during the middle of each morning and afternoon. Here's a typical month's consumption:

Milk	36,755	bottles
Tomato Juice	4,575	"
Orange Juice	888	"
Total	42,218	"

It is estimated that it takes a herd of 26 cows chewing their cud for 30 days to produce the milk. Who says Continental isn't looking out for the farmer?

KINGPIN OF SPEED CONTROLS

The Speedmaster was originally invented to provide infinitely variable speed (6 to 1 ratio) for DoAll Contour Machines. It wasn't long, however, before manufacturers of machinery in other fields discovered that this compact little unit was adaptable to their machines also. Today Speedmasters are controlling machine speeds in plants making hats, textiles, paper boxes, wire and metal products, bakery goods and even for cleaning tons of walnuts. Send for the new 40-page Handbook telling all about the many and varied applications of the Speedmaster.

Uncle Sam tells us that every ounce of metal saved is vital right now. DoAll saves tons and tons by slicing off metal or alloy as clean as a whistle. Makes no difference whether it's internal or external cutting, this ultra-modern production machine follows a hairline without any waste. Uncut portions of metal or alloy are usable.

Compare DoAll's economic performance with that of shapers, millers and other machines which reduce tons of metal to chips.

FASTEST METHOD TO REMOVE METAL

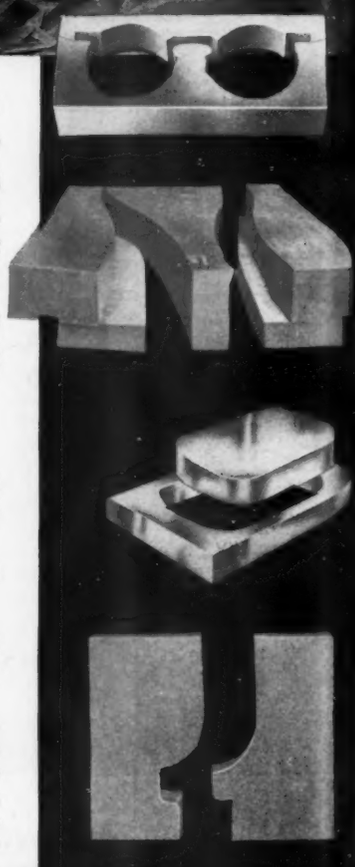
In production plants everywhere, DoAll is wrecking former time schedules—doing important sawing and filing jobs in one-half, one-quarter or one-eighth former time.

Let a factory trained man come to your plant with a DoAll and prove its metal and time saving ability to you.

A SIZE FOR EVERY JOB . . . There is a DoAll to do your particular job faster and better. Throat capacities from 16" to 60". Priced from $1000 to $5000, including motors.

NEW BOOK

"DoAll on Production" shows DoAlls at work in leading plants. An interesting story told in pictures. Send for copy.



CONTINENTAL MACHINES, INC.

1310 S. Washington Ave., Minneapolis, Minn.

Associated with the DoAll Company, Des Plaines, Ill., Manufacturers of Band Saws and Band Files for DoAll Contour Machines

Fast, accurate, dependable . . .

Fast, accurate, dependable . . . these three words are constantly mentioned when users state their experience with HARDINGE High Speed Precision Milling Machines.

Ruggedness is combined with extreme accuracy for ease of operation . . . high spindle speeds insure better finish as they afford proper cutting conditions.

Ask for our latest bulletin giving complete details.

SPECIFICATIONS:
Table: 25" x 6-1/2".
8 Speeds: 110 to 1850 R.P.M.
Cutter and Index Head have 1" Collet Capacity

"Performance has established leadership for **HARDINGE"**

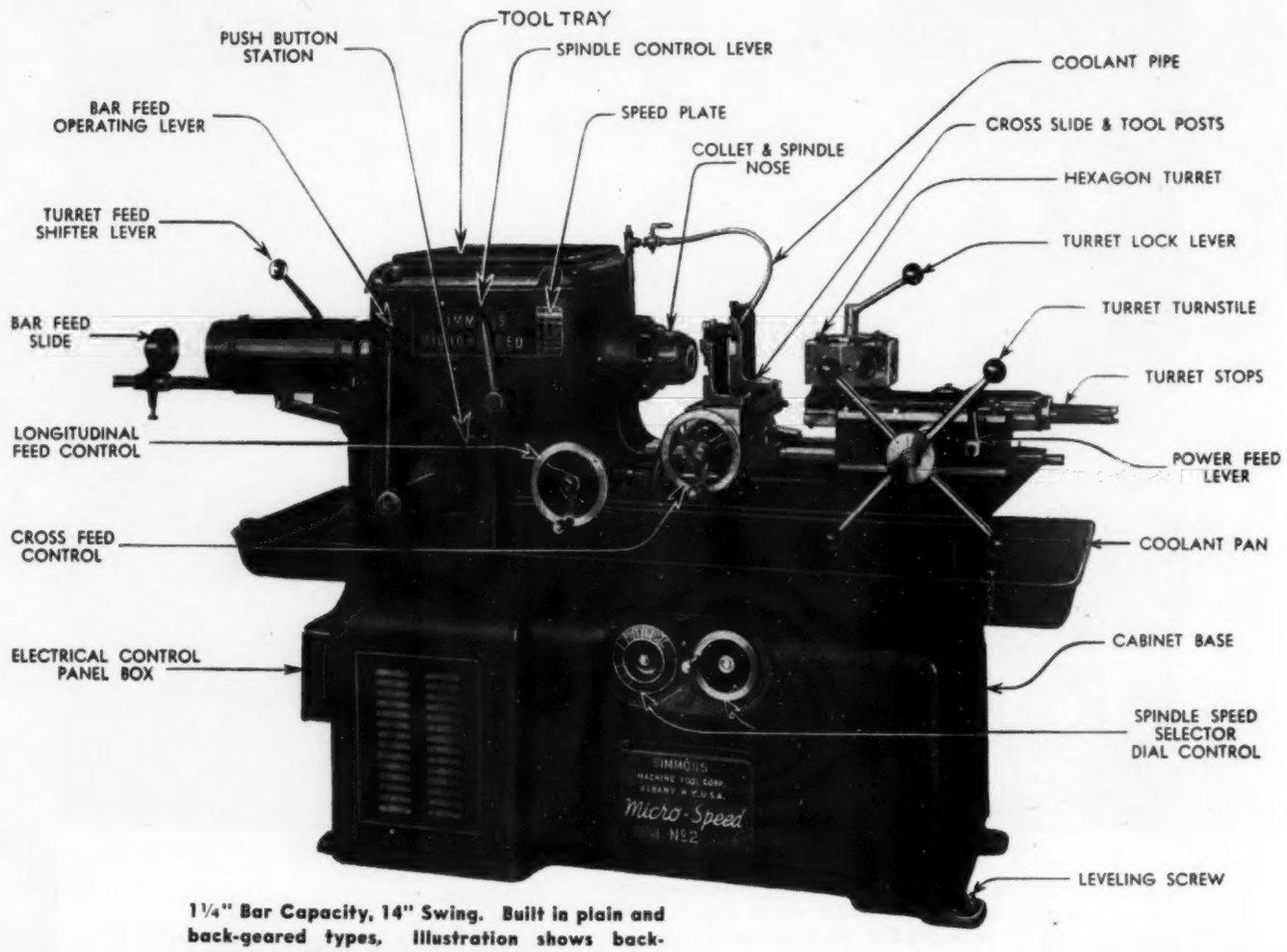
HARDINGE

HARDINGE BROTHERS INC., ELMIRA, N.Y., U.S.A.

EASE OF OPERATION MEANS . . .

SIMMONS NO. 2 TURRET LATHE

- MICRO-SPEED DRIVE
- SELECTOR DIAL CONTROL
- SPINDLE BRAKE AND CLUTCH



1¼" Bar Capacity, 14" Swing. Built in plain and back-geared types. Illustration shows back-geared machine. Timken Bearing Equipped.

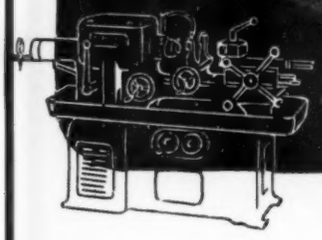
SIMMONS

MICRO-SPEED

REG U.S. PAT. OFF.

LATHES · TURRET LATHES · MILLERS · BORING MACHINES

HIGHER PRECISION . . . *Faster!*



Eight Simmons Turret Lathes at work in the plant of Swift Lubricator Company, producing aircraft bushings held to .0005", reamed to .001" and held to length within .005". Thousands each day! That's what we mean by "Higher Precision . . . Faster!"

Designed for simplicity of operation, with a minimum of confusing devices, these Simmons Turret Lathes make it easy for even inexperienced operators to produce high-precision work quickly. For example, the Micro-Speed Drive offers unlimited speed variations and all changes can be made while the spindle is in operation. This enables quick selection of the speed best-suited to the work and cutting tools. A simple oversized brake brings the spindle to rest quickly.

Write today for descriptive bulletins and complete specifications. Our delivery schedule is reasonably quick.

SIMMONS MACHINE TOOL CORPORATION

Main Office: **1759 NORTH BROADWAY, ALBANY, N. Y.** ***New York Office:*** **149 BROADWAY**

WISCONSIN MOTOR CORPORATION CUTS COSTS, DOUBLES PRODUCTION WITH CLEVELAND *Single Spindle* AUTOMATICS

● Down went costs and up went production for Wisconsin Motors Corporation when Model B Cleveland *Single Spindle* Automatics went to work on a variety of small, simple parts they require, in large quantities and small. Says a shop executive, "These machines are a step ahead in progress. Their excellent performance, low tooling costs, precision machining and productivity makes them profitable to operate."

Model B Clevelands are used throughout industry for metal turning jobs which are simple but where high production is required. Tap blanks, shafts with multiple diameters, nipples, various types of studs and pins, are all produced most economically on Model B machines.

Cutting tools can be mounted singly or in series for turning one or more diameters of various lengths. Double cross-slides carry forming and cutting-off tools. Built in long and short lengths to accommodate work up to 18-inch stock feed, Model B Clevelands can be equipped with rotary tilting magazines or hopper magazines for secondary operations. Model B will take work up to 2½-inch diameter bar stock.

If you have a type of job which you suspect can be best produced on Model B, ask our representative to call and talk it over with you. A bulletin describing Model B will be sent on your request.

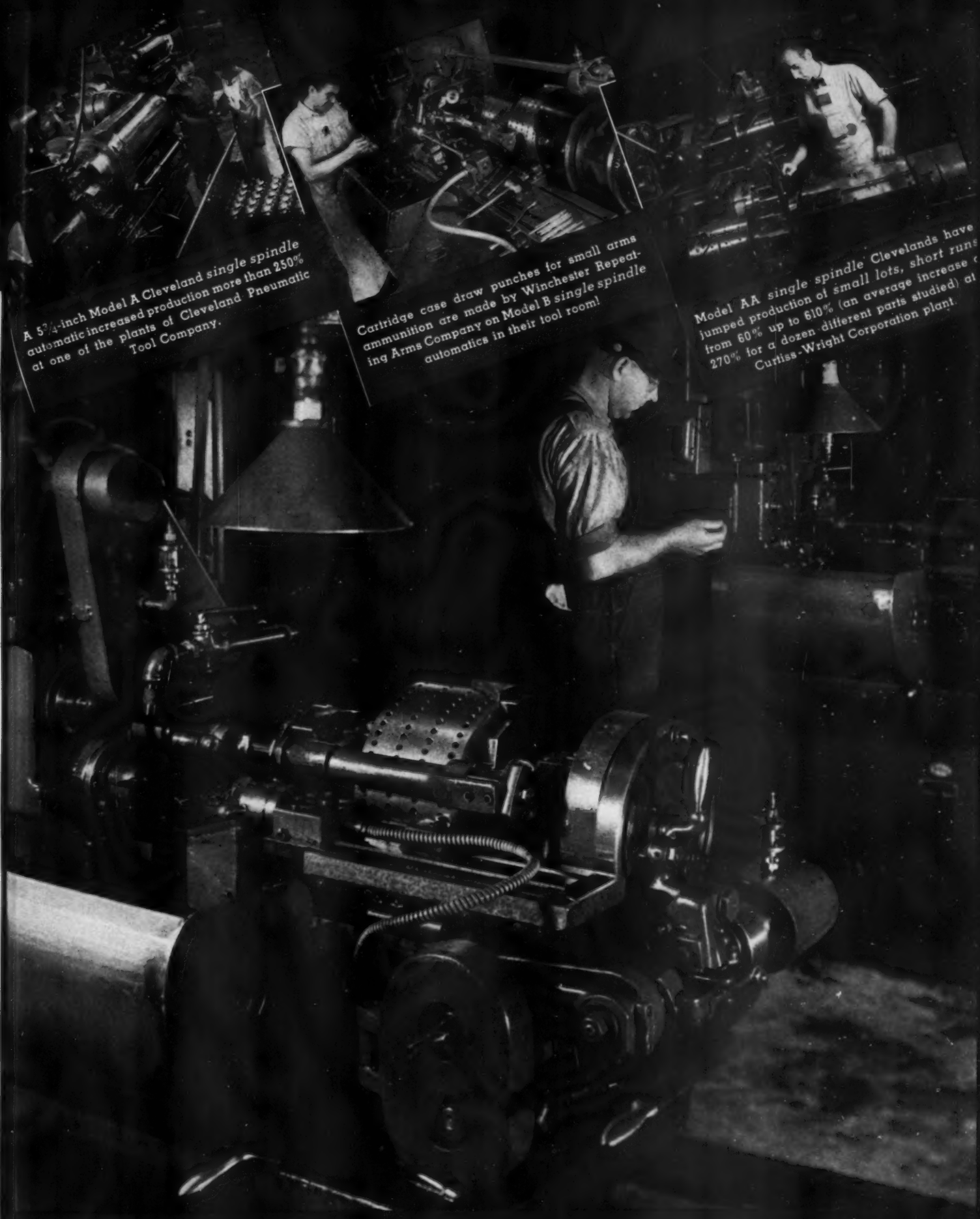
THE CLEVELAND AUTOMATIC MACHINE COMPANY

2269 ASHLAND ROAD · CLEVELAND, OHIO

Sales Offices: CHICAGO: 565 W. Washington Street • DETROIT: 540 New Center Building
NEWARK: 702 American Insurance Building • CINCINNATI: 507 American Building

★ ★ ★ ★ ★ ★ ★

Consider **Cleveland *Single Spindle* Automatics if you make duplicate parts in small quantities. By using *single spindle* automatics the increased production obtained from them may release a number of other critical machine tools for other purposes.**



A 5¾-inch Model A Cleveland *single spindle* automatic increased production more than 250% at one of the plants of Cleveland Pneumatic Tool Company.

Cartridge case draw punches for small arms ammunition are made by Winchester Repeating Arms Company on Model B *single spindle* automatics in their tool room!

Model AA *single spindle* Clevelands have jumped production of *small lots, short runs* from 60% up to 610% (an average increase of 270% for a dozen different parts studied) at Curtiss-Wright Corporation plant.

CLEVELAND *Single Spindle* AUTOMATICS

MODEL A—Built in 9/16-inch to 8-inch capacities inclusive

MODEL B—Built in 9/16-inch to 2½-inch capacities inclusive

5-METHOD
COMPLETE TOOL SERVICE *for* MAXIMUM PRODUCTION

Vascoloy RAMET

5 4 3 2 1

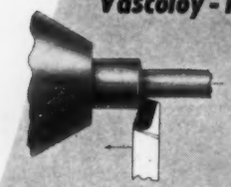
STANDARD TOOLS

1 CEMENTED CARBIDE

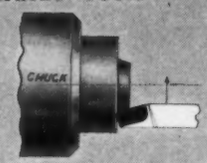
for many machining operations on most materials

• • •

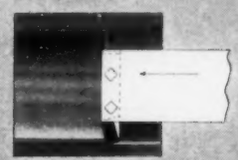
A Few Applications of Standard Vascoloy-Ramet Carbide Tools



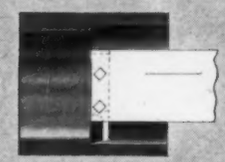
Ordinary Turning
Styles 11 and 12



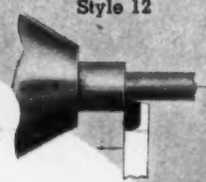
Ordinary Facing
Style 12



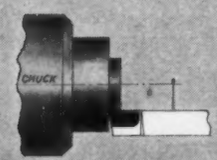
Boring
Style 12



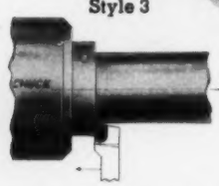
Boring to a Square Shoulder
Style 6



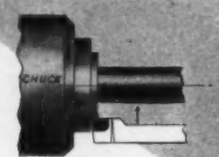
Turning to a Square Shoulder
Style 3



Facing to a Square Shoulder
Style 6



Turning Close to Chuck
Style 1



Facing
Style 2

Method One of the Vascoloy-Ramet Tool Service offers a wide variety of standard carbide-tipped tools. They are finished ground and used as they are. They are also modified to meet the requirements for simple form tools.

While the accompanying illustrations show only a very few applications of some of the Vascoloy-Ramet Standard Tools, the boring, turning, and facing operations that are being done on cast iron, aluminum, bronze, and steels with these standard tools, is practically countless. Because of the many styles and sizes, and the choice of several general purpose grades of Ramet Carbide Blanks, simplified tooling practice recommends this Method One wherever possible.

These standard tools will simplify and speed up your tooling work. Write for your copy of bulletin VR 421 for full particulars.

• • •

VASCOLOY-RAMET CORPORATION

NORTH CHICAGO, ILLINOIS

DISTRICT SALES AND SERVICE IN PRINCIPAL CITIES

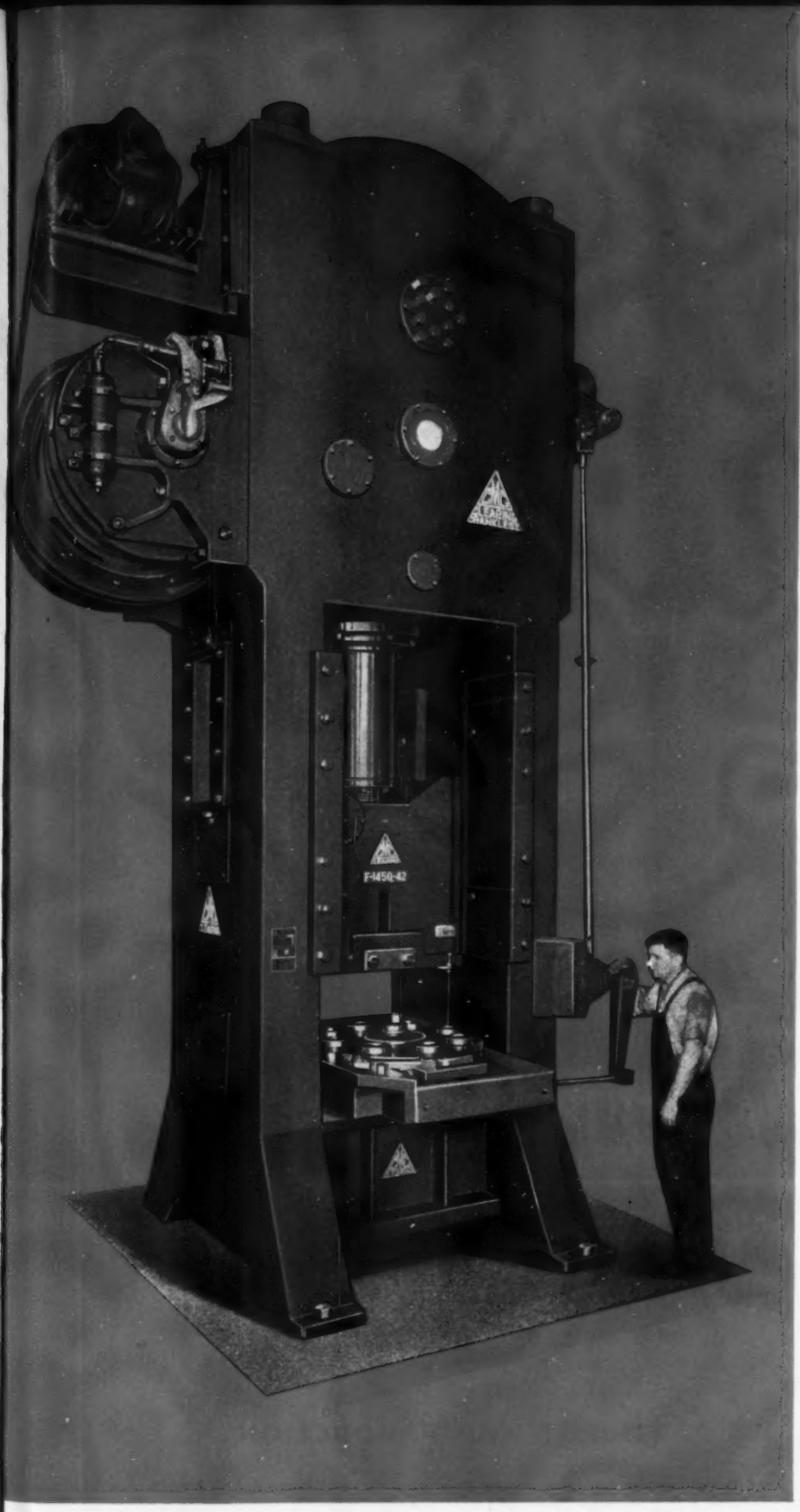
IN CANADA: Carbide Tool & Die Company, Ltd., Hamilton, Ont.

4249

TANTALUM-TUNGSTEN CARBIDE

FOR TOOL SERVICE..... *Specify* Vascoloy RAMET TOOLS

TANTUNG "G"



"Without it"

CARTRIDGE CASES CANNOT BE USED AGAINST THE AXIS

The finished product must be stamped with the Army's official o.k. In order to receive this o.k., cartridge case manufacturers must have machines they know are exacting in design and workmanship. Embodied in the design of CLEARING presses, such as the one illustrated, is the patented plunger guided slide and in addition, four individually adjustable gibs which doubly insures perfect die alignment. Further insurance toward the official o.k. is an extremely well-built dial feed which feeds two cases into the dies at each stroke of the press while the press is operating at a very rapid rate of speed.

One has only to check with leading cartridge case manufacturers to find that CLEARING presses are proven.

Clearing Machine Corporation
6499 West 65th Street, Chicago, Illinois

MECHANICAL AND HYDRAULIC PRESSES

CLEARING

MACHINE CORPORATION

CHICAGO

OFFICIAL U. S. NAVY PHOTOGRAPH

America's Answer

Off the production lines of American industry in tremendous volume roll the planes, tanks, anti-aircraft guns and munitions.

American industry gives the answer to the Axis, and there isn't any doubt about the outcome.

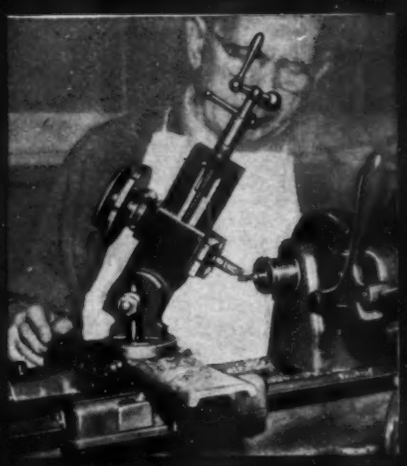
To have a share in this vast enterprise is a privilege every American counts with pride. In our plant we are working night and day producing precision parts vital to winning the war.

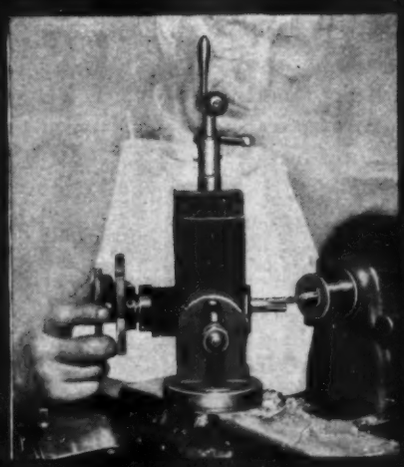
PRECISION BUILT PARTS FOR WAR PRODUCTION

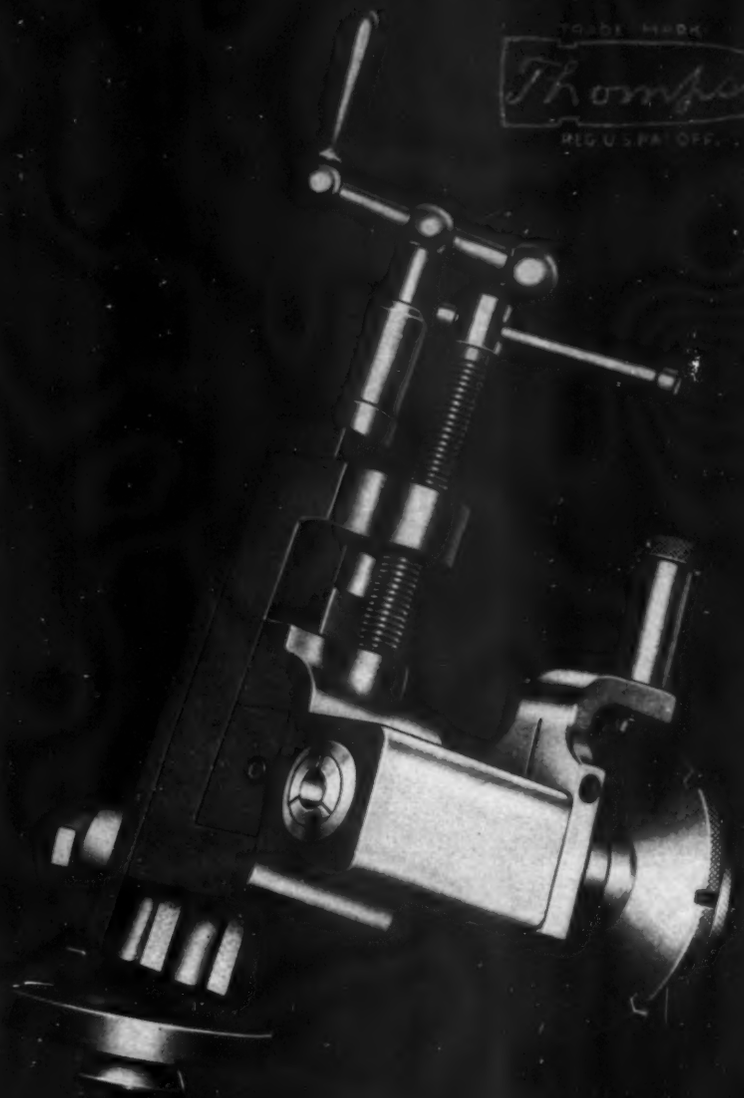
FENN

THE FENN MANUFACTURING CO.

HARTFORD, CONNECTICUT • ESTABLISHED 1900







Thompson

UNIVERSAL MILLING FIXTURE

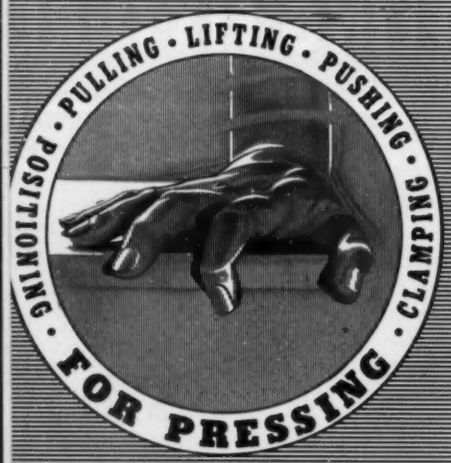
for efficient toolroom or production use

GET GREATER VERSATILITY ON STRAIGHTENING OPERATIONS

THE DLSC2 HydrOILic PRESS

in 25, 50 and 100-ton Capacities

INDUSTRY'S NEW RIGHT HAND



DENISON EQUIPMENT—APPLIED HydrOILics

OPERATION

Operation is extremely simple. The ram is held in place HydrOILically when it reaches the upper stroke limit, and the pump and motor idle, using minimum HP. Down movement of the control lever causes the ram to move downward at rapid traverse speed exerting minimum tonnage, until it contacts the work. Further downward movement of the control lever increases the tonnage, and the tonnage increases in direct proportion to the pressure exerted on the lever. Release of the control lever moves the ram upward to the upper stroke limit. All principal moving parts operate in a bath of oil, reducing wear and maintenance costs.

Priorities still have first call on HydrOILic Press output. But since conditions may change rapidly — even if only temporarily — we suggest you submit your requirements to us without delay. We'll tell you promptly the delivery we can make in your particular case.

SPECIFICATIONS

	DLSC2 50
MAXIMUM WORKING CAPACITY – TONS	50
CYLINDER BORE INCHES	8
RAM SPEED, DOWN (RAPID TRAVERSE) F.P.M.	12
RAM SPEED, DOWN (HIGH PRESSURE) F.P.M.	1
RAM SPEED, UP F.P.M.	27
PUMP VOLUME GALLONS PER MIN.	30 5
MAXIMUM WORKING PRESSURE, P.S.I.	2000
MOTOR H.P. 1200 R.P.M.	7½
RAM DIAMETER INCHES	6
RAM THREAD FEMALE, SIZE, PITCH	2-8
OIL RESERVOIR CAPACITY – GALS	50

WHEREVER YOU NEED POWER • SPEED • CONTROL

Check DENISON EQUIPMENT—APPLIED HydrOILics

You'll find new skilled help on your straightening jobs in this DLSC2 straightening press, with its extra flexibility and accuracy. Equally efficient on small-lot operations and production-line work, this press handles almost any type of straightening — round bars, flats, castings, finished parts, and structural shapes.

Denison design has built easy adaptability into the DLSC2 — tonnage is quickly adjustable from one-tenth to full capacity, and speed may be varied with either controlled-orifice valves or variable delivery pumps. Control is simple, direct, and easily accessible to the operator; movement of the hand-lever or foot-pedal is all that is required.

Compact and self-contained, with rounded corners and enclosed construction, it gives you double advantages of safety and space-saving.

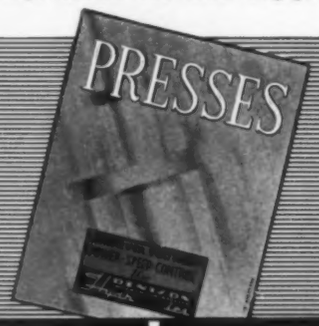
Improvements like these, in design, in performance, in versatility, have made Denison HydrOILics "Industry's New Right Hand" . . . and today this new right hand is right in the middle of the war effort, turning out the goods.

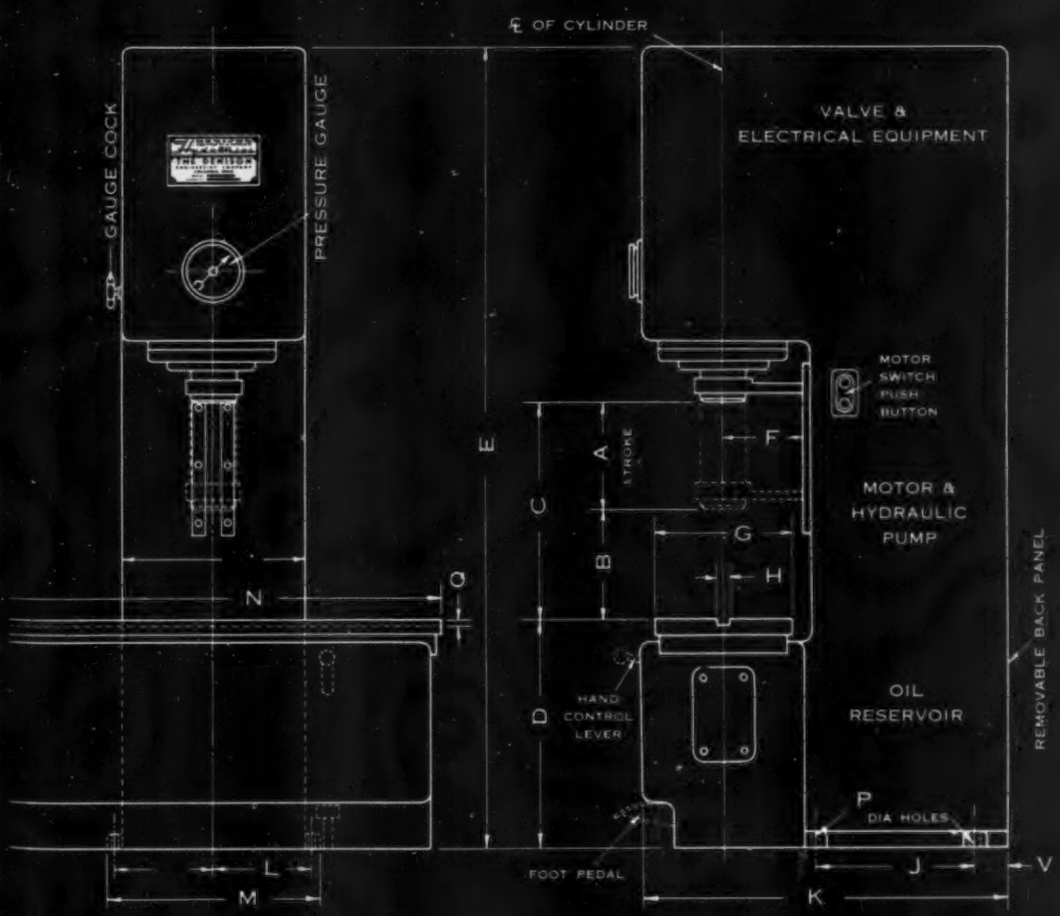
Even if your production problem is entirely new, you can profit by Denison's experience and full technical and research facilities. For help on any press problem — assembling, straightening, bending—write, wire or phone The Denison Engineering Company or your Denison representative.

COMPLETE DATA ON HydrOILic PRESSES!

You'll want this newest catalog on the full line of standard Denison HydrOILic presses. It may point the way to more efficient POWER, SPEED, AND CONTROL on your assembling, straightening, and bending.

EXTRA! Twelve full pages of indexed engineering tables for quick reference, are included in this catalog. Write for free copy.





DIMENSIONS

	DLSC2 50
A	18
B	12
C	30
D	30
E	106
F	12
G	18
H	1
J	21
K	50
L	13
M	29
N	60
P	
Q	
S	25
V	4
W	8000
X	8050
Y	8150
Z	231

HydrOILic STRAIGHTENIN PRESS

CAPACITIES: 25, 50, 100 TON

MANUAL CONTROLS

MAX. WORKIN PRESSURE 2000 P.S.I.

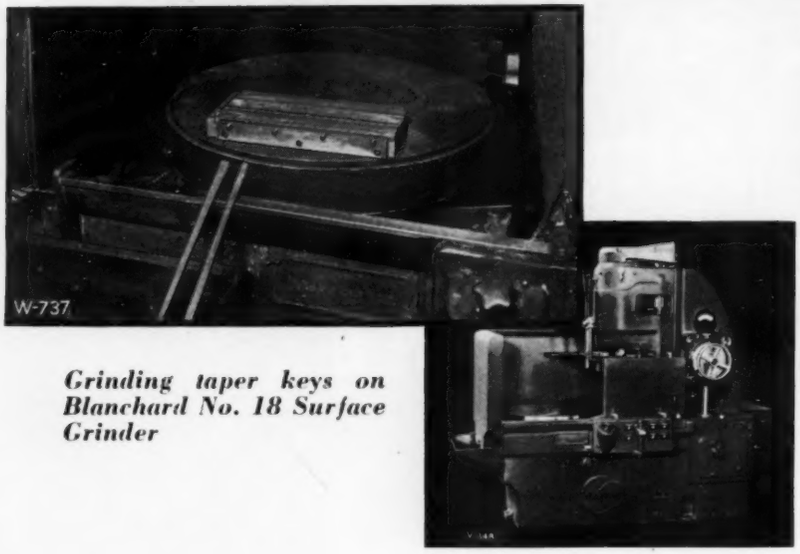
MAXIMUM STROKE: 18'

MAX. THROA OPENING: 20

MAX. VERTICA OPENING 30"

THE DENISON ENGINEERING COMPANY

164 Dublin Road — Columbus, Ohio



Grinding taper keys on Blanchard No. 18 Surface Grinder

EVEN though fixtures are sometimes necessary on a Blanchard Surface Grinder, a simple design is often very satisfactory. A simple tapered shoe is used for holding 16 tapered keys in the set-up shown above. $\frac{1}{4}''$ to $\frac{1}{2}''$ of stock is removed from one side of each key to limits of .002". 48 pieces are ground per hour.

If greater production is required, two fixtures could easily be accommodated on the 36" magnetic chuck. Magnetism holds the fixture on the chuck and helps to hold the work down in the fixtures.

BLANCHARD

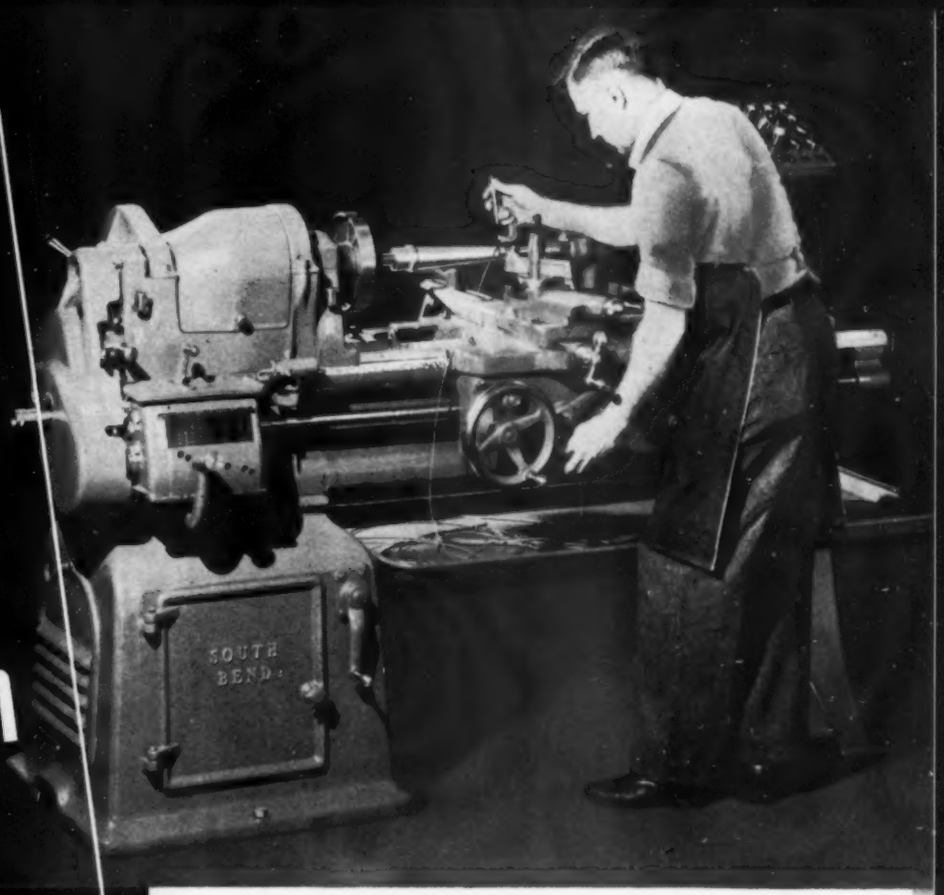
CHECK THESE ADVANTAGES OF BLANCHARD GRINDING

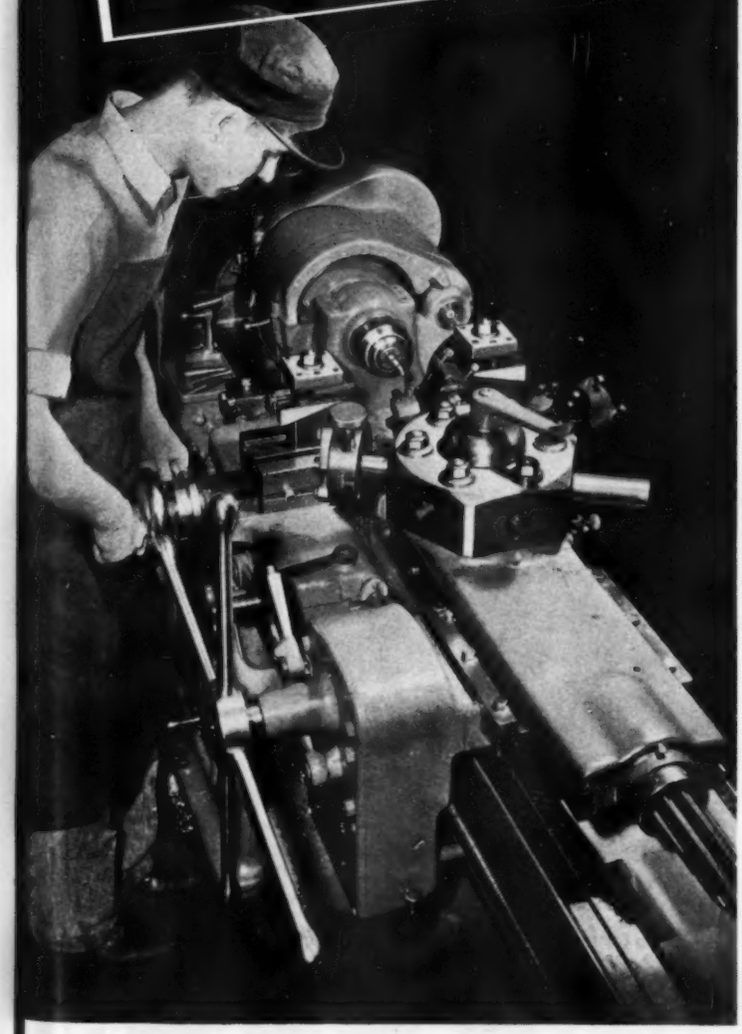
- ★ **Production**
- ★ **Adaptability**
- **Fixture Saving**
- **Operation Saving**
- **Material Saving**
- **Fine Finish**
- **Flatness**
- **Close Limits**

★ . . . . . *Especially valuable on jobs like the one illustrated.*

Send for your free copy of "Work Done on the Blanchard." This book shows over 100 actual jobs where the Blanchard Principle is earning profits for Blanchard owners.

Matched for Production





SOUTH BEND Turret Lathes matched with South Bend Engine Lathes make a team that is hard to beat for the production of precision parts.

Take advantage of the time-saving features of South Bend Turret Lathes for work that is adaptable to multiple tooling and simultaneous cuts. Use South Bend Engine Lathes for second operations, turning between centers, and for the difficult jobs that require engine lathe versatility. And select South Bend Toolroom Lathes for your precision toolroom work.

There is a practical size and type of lathe for every class of work. South Bend Engine Lathes and Toolroom Lathes are made in five sizes: 9″, 10″, 13″, 14½″ and 16″ swings. South Bend Turret Lathes are made in three sizes: No. 2-H, Series 900, and Series 1000. Write for a copy of our new Catalog No. 100B in which the entire line of South Bend Lathes is illustrated and described.

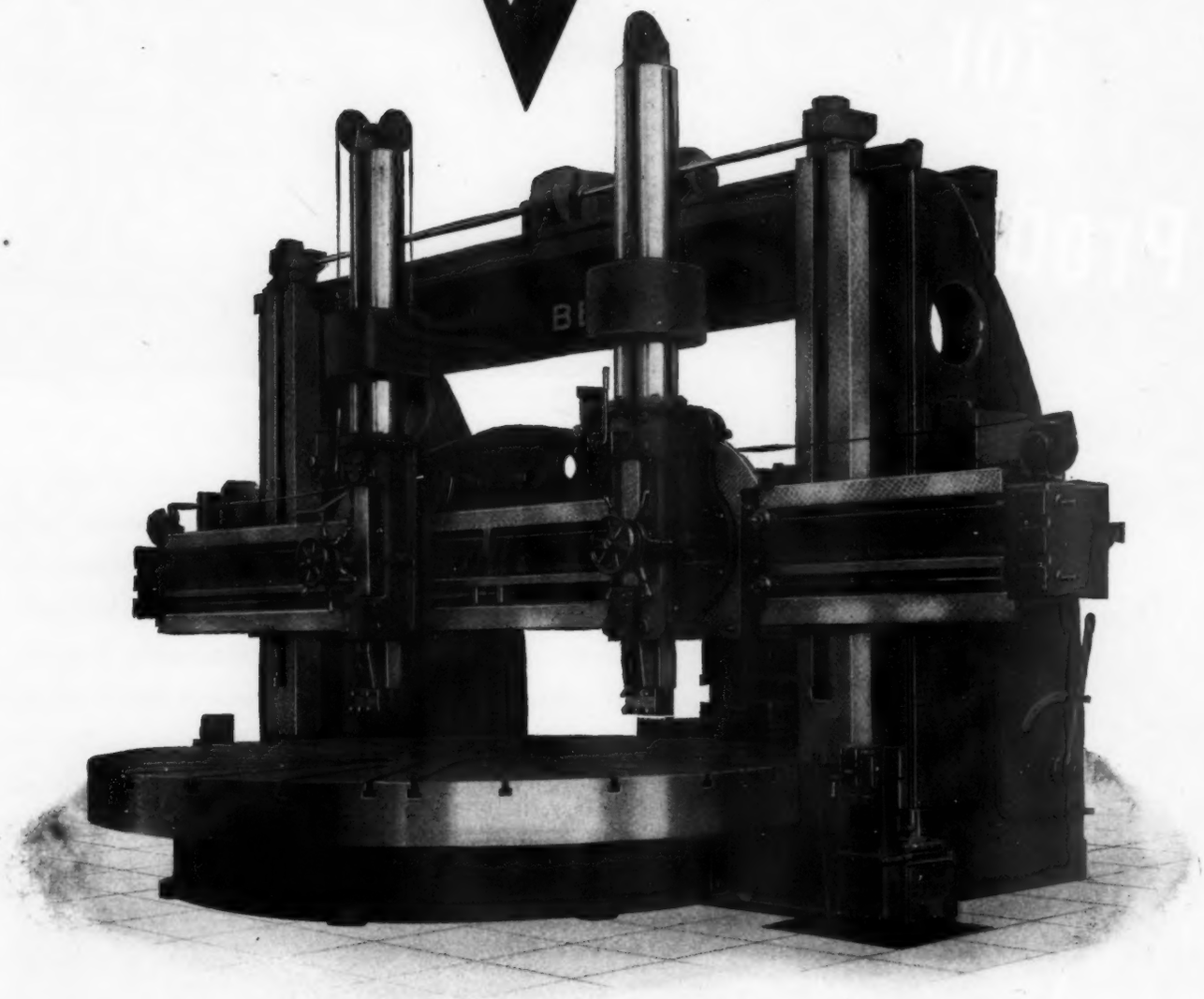
ALL-NAVY "E" BURGEE awarded to the South Bend Lathe Works for outstanding performance in the production of Navy matériel.

SOUTH BEND LATHE WORKS

Dept. 231, South Bend, Indiana

Lathe Builders For 35 Years

FOR VICTORY



Betts Boring Mills have many new and exclusive features that make them outstanding for the tremendous jobs imposed by our Victory Program. A very high degree of accuracy is provided. Operation of the machines has been simplified by motorization of the various functions and improved lubricating systems have lessened the task of maintenance.

BETTS • BETTS-BRIDGEFORD • NEWTON • COLBURN • HILLES & JONES • MODERN

CONSOLIDATED
MACHINE TOOL CORPORATION
ROCHESTER NEW YORK

Industrial DRILLING Practices...

MACHINE: The Super Service Radial with 3 ft. arm and 9-inch column, power elevation, automatic tapping reverse, and plain table.

PLACE: At a North Quincy, Mass., Packaging Machinery Plant.

JOB: Drill, ream and tap holes in bracket.

REMARKS: Small pieces are accommodated on either top or side of plain table and large pieces are easily held in position on base.

Write us for further information on this or any other Cincinnati Bickford Super Service Metal Drilling Machine.

THE CINCINNATI BICKFORD TOOL CO.

OAKLEY · CINCINNATI · OHIO · U. S. A.

He worked out a Neat Way to Hold Groove Spacing to Close Limits

Martin M. Klimko, (left, in photo above) is an assistant foreman in the machine shop of the Youngstown Sheet and Tube Co. One job called for cutting accurate grooves in a thrust bearing. The accompanying sketch shows how Klimko makes up a number of steel blocks shaped and ground equal to the pitch of the grooves to be cut. These are placed between the stop dog and master stop. After cutting the first groove, one block is removed and the carriage moved up to the second block, thus positioning the cutter to correct spacing for the second grooving cut. *By putting this job on a turret lathe and employing this method, time was cut from 16 hours to 3 hours per piece.*

Martin Klimko offers this idea with the hope that others may find the principle involved of help on some of their turning jobs. We hope he is as pleased in receiving his gold Victory Pin as we were in sending it as an acknowledgment of his cooperation.

Many of the ideas sent to us are published in Blue Chips, a shop bulletin printed especially for turret lathe operators and sent free to their homes. Nearly 30,000 operators are on our list. We believe the interchange of practical shop ideas can be particularly valuable throughout the war effort. Why not make sure your operators are getting Blue Chips? Write Warner & Swasey, Cleveland.

YOU CAN TURN IT BETTER, FASTER, FOR LESS . . . WITH A WARNER & SWASEY

WARNER & SWASEY FOR VICTORY

WHAT'S IN THIS ISSUE

UNBRIDLING THE MUSTANG

North American Aviation has done a fine job of planning the production of its fast fighting plane, the Mustang. Subassemblies are built up step by step until they flow into the final assembly line. Tools and materials are supplied to the operators at the proper points. Assembly jigs are complete with compressed air and electric outlets, portable tools and rivet boxes. Gary Stroh, North American's final assembly supervisor, tells all about it. Page 905.

GARY STROH

HIGH NICKEL

Nickel is scarce today for the reason that it is so essential in war products. One of our previous blue-paper sections on the working of materials dealt with nickel alloy steels. In this issue a similar section tells how to work high-nickel non-ferrous alloys. Page 885.

NYA WELDERS

Because of the fact that nobody can argue against vocational training, this activity is one which many agencies have used to justify their existence. The National Youth Administration has included training projects in its program, and its records show that a large number of young men and women have acquired skill through its efforts during the last year. John E. Ryckman, National Youth Administrator for Illinois, describes his organization's methods of training welders. Page 875.

R. F. APTER

HARRY W. SMITH, Jr.

CITY GAS

Flame hardening has attracted many shops by the small investment needed for its use. The oxyacetylene torch provides a portable and convenient means of hardening steel parts, both large and small. A still newer development has been the use of city gas and air through burners especially designed for this process. Gas-air flame hardening is the subject of a new series of articles by R. F. Apter, and Harry W. Smith, Jr., The Selas Company. The first installment appears in this issue. Page 871.

HOLES FOR TAPPING

Reference Book Sheets in this issue continue the new standard on tap drill sizes as compiled by the National Bureau of Standards. A feature of the tables that go with the standard is the percentage of thread depths given for each size of drill. Page 913.

SCRAP HANDLING

The scrap drive is on. In every city and town the public is being impressed with the necessity for saving materials formerly cast away. In large industrial plants the problem is chiefly one of materials handling. John L. Hare, General Electric Company, describes the way his company transfers scrap from the machine direct to a dump truck body. Page 881.

MACHINING A HEAD

Increased production on its line of lathes led the Axelson Manufacturing Company to adopt some novel manufacturing improvements. Among these were a double-end machine for boring the main bearing holes in headstocks; a new method of transporting parts to the assembly floor; and a portable tool kit to hang on the casting while the parts are being installed. All of which shows that this enterprising Pacific Coast concern is on its toes. Page 878.

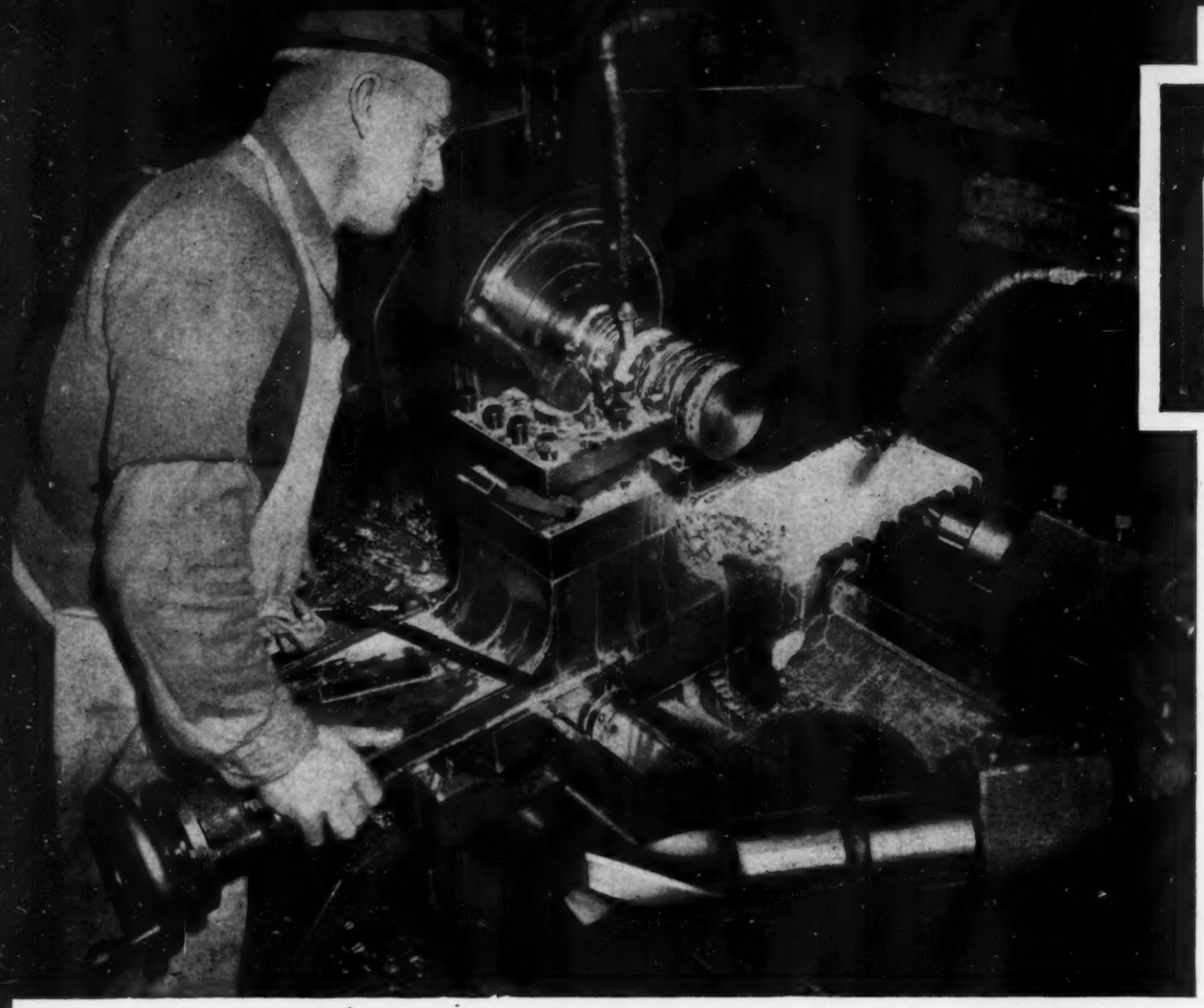
MORE ON JIGS

John G. Jergens, Cleveland Pneumatic Tool Company, concludes his series on jig and fixture details. This time he describes several types of work-supporting devices and vise jaws for holding several parts at once. Page 876.

COMING

Anything that will produce weapons faster is hot news right now. Captain E. G. Moffatt, of Watervliet Arsenal, has done a lot of work in the application of cemented-carbide tools in machining steel forgings. His article on the subject is not confined to a recital of successful results. He gives the cutting angles, feeds and speeds, so that other shops may profit by his experience.

The manufacture of aircraft exhaust manifolds at the Ryan Aeronautical Corporation has been changed from a job shop basis to flow production. It took considerable planning to accomplish the changeover, but the benefits in increased production were well worth it. Ernest A. Moore, factory superintendent of this company, will tell how it was done. Ryan furnishes manifolds for many types of airplanes, both military and commercial, and its revised methods are based on sound practice.



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TURN THEM FAST!
to Speed Production for VICTORY!

Cincinnati-Acme Universal Turret Lathes have the correct speeds to take full advantage of fast-cutting carbide tools. At the American Locomotive Works, the 3S Cincinnati-Acme Universal Turret Lathe shown above is roughing out blanks for locomotive knuckle pins from 4½" diameter bar stock.

To insure accurate performance on jobs like this, both the square and the main turrets of Cincinnati-Acme Lathes are mounted with unusual rigidity. The square turret saddle is gibbed to both vees and a third taper gib on the front of the bed is extra assurance of rigidity. A wide inverted dovetail holds the cross-slide to the saddle. That is why we say that, with Cincinnati-Acme Universal Turret Lathes, you can load up to full capacity, turn at the highest speeds and get maximum output on all your jobs of production for Victory!

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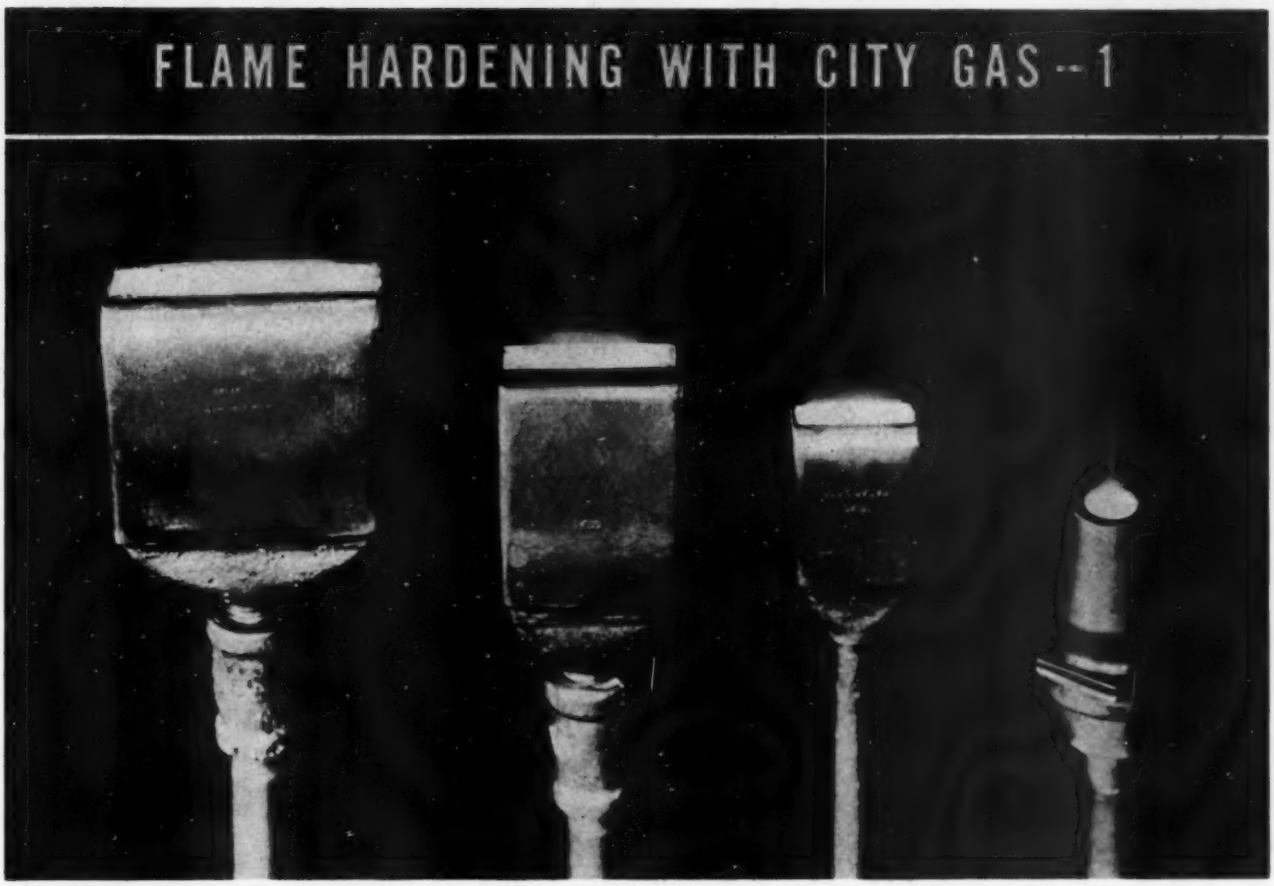


Fig. 1—Compacted or superheated burners for flame-hardening with premixed city gas and air are, in effect, tiny furnaces which concentrate a large amount of heat on a small area

Burners for Localized Heating

BY R. F. APTER and HARRY W. SMITH, JR., THE SELAS COMPANY

Premixed city gas and air can now be used successfully for flame-hardening and annealing

FLAME-HARDENING was first done with the oxyacetylene torch. Between 1926 and 1930 oxygen-using methods of heating high-carbon steels locally beyond their critical temperatures and subsequently quenching to establish regional surface hardening were adapted to the regular production of crankshafts, gears, shafting, tools, ball races, dies, rails, valves and knives. During these years the technique of mechanization, flame control and quenching was learned.

Up to 1940 most applications of city gas and air premixtures to flame-hardening had been "home-made" by the user (or his fuel consultants) and were confined to the treatment of light-section work. Practically no equipment engineered for high-rate gas-air flame-hardening was available for industry-wide application. Now, however, such equipment is available.

Researches involving fundamental approaches to the combustion of gas-air premixtures have brought about the development of burners capable of concentrated heat deliveries at flame temperatures sufficient to widen greatly the scope of gas flame-hardening.

Already flame-hardened on high-production schedules by gas-air methods are: machine tool transmission gears,

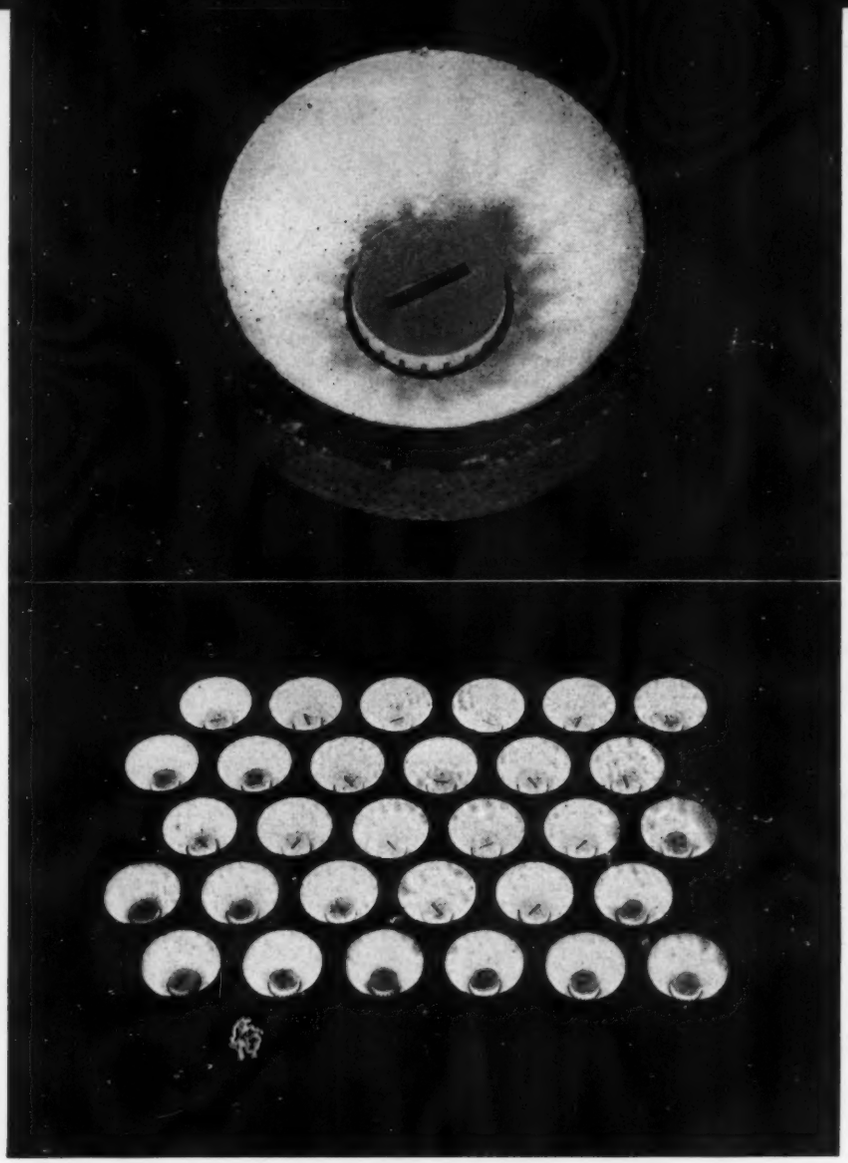


Fig. 3—Radiant burners are available with open face diameters up to 6 in. Hexagonal block assemblies permit close spacing of radiant cups

bandsaws, hacksaws, valve stems and valve balls, automotive camshafts, military tank tread sprockets, automotive starter-flywheel gears, antiaircraft and machine gun parts in amazing variety, shearing knives, skate blades, valve rockers, coupler jaws, huge road machinery drive gears and Army shell. Among the products similarly flame-annealed (by identical localized heat-treatment, but without quench) are: automotive steering-segment shafts, tie-rod-ball shanks, brass cartridges, telephone jacks, cold-headed bolts and the flame-cut ends of heavy armor plate.

Three types of heating elements operate on premixtures of city gas and air; all of them have been successfully adapted to flame-hardening and flame-annealing. All three types are refractory (rather than metal) burners, so that ports and combustion chambers will retain contour and dimensional specifications under protracted periods of high-temperature operation in open air. Thus, scaling, corrosion or melting-down of metal parts are eliminated. Also a minimum of heat is conducted away by the burner body. The metal housings shown in Figs. 1 and 5 are not particularly high-heat elements, nor elements of primary dimensional or functional importance, and may, therefore, be used in the interest of increased ruggedness.

The character of the heat delivered, the degree of heat-concentration produced and the mechanics of heat transfer from burner to production part, are all radically different in these three distinct types of flame-hardening burners. Let us refer to the combustion in

Fig. 2—Refractory-lined burners of the type shown in Fig. 1 are easily adapted to the flame-hardening of gear teeth and other surfaces where the mass of the metal part in the immediate vicinity of the surface is not too large. The white arrows indicate radiant heat and the gray areas indicate the flow of hot gases

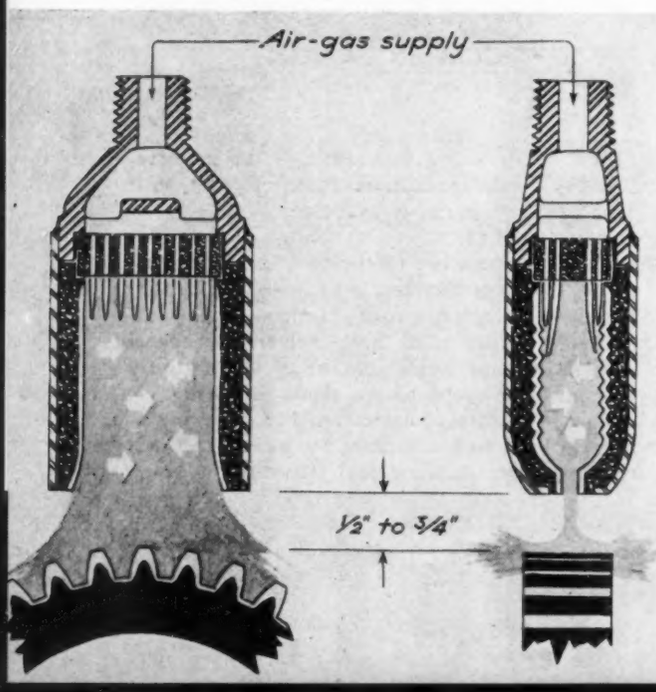
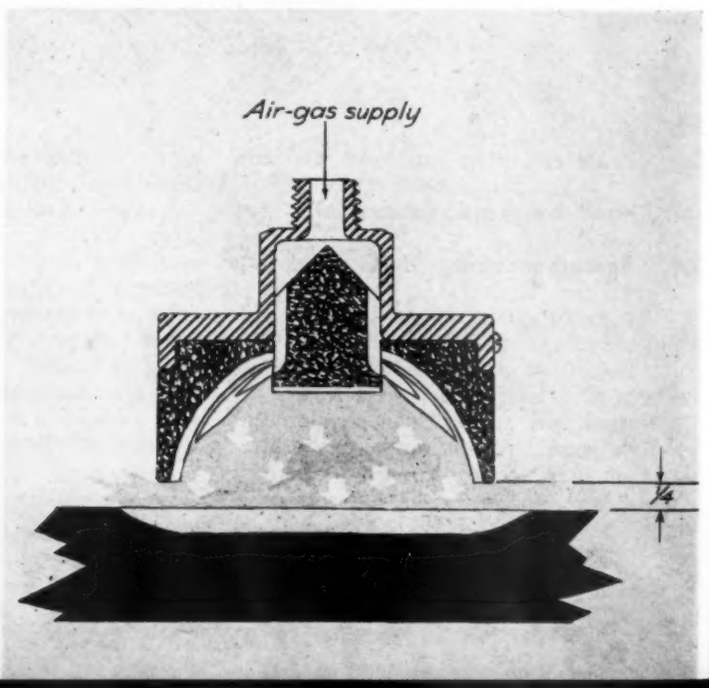


Fig. 4—In this "radiant" burner for premixed city gas and air, the white arrows indicate radiant heat, the gray areas the flow of hot gases as convected heat and the white areas incandescent surfaces. This burner is generally most effective in hardening the surfaces of heavy sections and is characterized by its large heating area



burners like those shown in Figs. 1 and 2 as "compacted" or "superheated"; to the combustion in burners of the type shown in Figs. 3 and 4 as "radiant"; and to the combustion in burners like those in Figs. 5 and 6 as "distributed."

As may be seen in Figs. 1 and 2, the "compacted" or "superheated" combustion burners are: (1) lined with high-temperature refractory, (2) constricted at the outlet, and (3) capable of holding the flames totally within the burner and on the ports of a refractory-plate burner-screen located in the base or the heel of the burner.

Hot Walls Raise Temperature

The burner is, in effect, a tiny furnace whose interior walls achieve white-hot incandescent temperatures. Thus, unusually large amounts of gas and air can be completely burned in a minimum space. The high radiant heat output of the incandescent refractory lining accelerates the rate of combination of gas and air, or "superheats" the reaction, so that higher rates of heat liberation can be attained than would otherwise be possible. Tests have shown that outlet gas temperatures are 200 to 500 F. higher than would be developed under similar conditions but without incandescent walls closely surrounding combustion and without constriction of the outlet. It must not be assumed that with this burner substantial radiant energy impinges upon the work. As can be seen in Fig. 1, the outlet slots of the burners (which face the work) are very narrow. The considerable radiant heat developed in these burners is utilized almost wholly to accomplish the "superheating" effect as the combustion reaction proceeds.

The burner shown in Figs. 3 and 4 is a true "radiant" burner—in the sense that the radiant energy emitted from the relatively large area of the incandescent refractory cup actually impinges upon the work piece. Thus, the rate of part heating with such a burner is accelerated by the added radiant component. When the face of such a burner is placed close to the work the combustion is automatically "compacted," as with the "superheat" burner.

The "radiant" type differs, of course, in the area over which heat energy is transmitted to the work. Such burners are available with open face diameters up to 6 in. (or 28.3 sq. in.) whereas the outlet slots of the burners shown in Fig. 1 have openings of only $1\frac{5}{16} \times \frac{3}{16}$ in. (0.36 sq. in.), $1\frac{1}{8} \times \frac{1}{8}$ in. (0.14 sq. in.), $\frac{3}{4} \times \frac{1}{8}$ in. (0.09 sq. in), and $\frac{1}{4}$ in. diameter (0.05 sq. in.).

The "radiant" burner, further, provides high rates of heat transfer to the work because of a high "radiant head" (temperature differential between the incandescent refractory surface and the work piece) and the close distance between radiator and receiver. In some burner designs, the incandescent refractory cup surface reaches a temperature of 2,850 F., and in others currently in the process of development even higher surface temperature limits are indicated.

Combustion in the burners shown in Figs. 5 and 6, has no significant radiant component. Such burners produce precisely controllable parallel flames of uniform length, distributed over the area represented by the rafractory burner screen. Thus, heating can be evenly distributed over the work piece. To get maximum heating speeds from such burners, the work should be located just beyond the tips of the primary cones of the component flames—a point widely recognized as the hottest in the combustion reaction. Though efficient in heating speed, such "distributed" combustion burners are not generally as efficient in fuel consumption as the "radiant" type for their only methods of transferring heat to the work are by convection and flame contact.

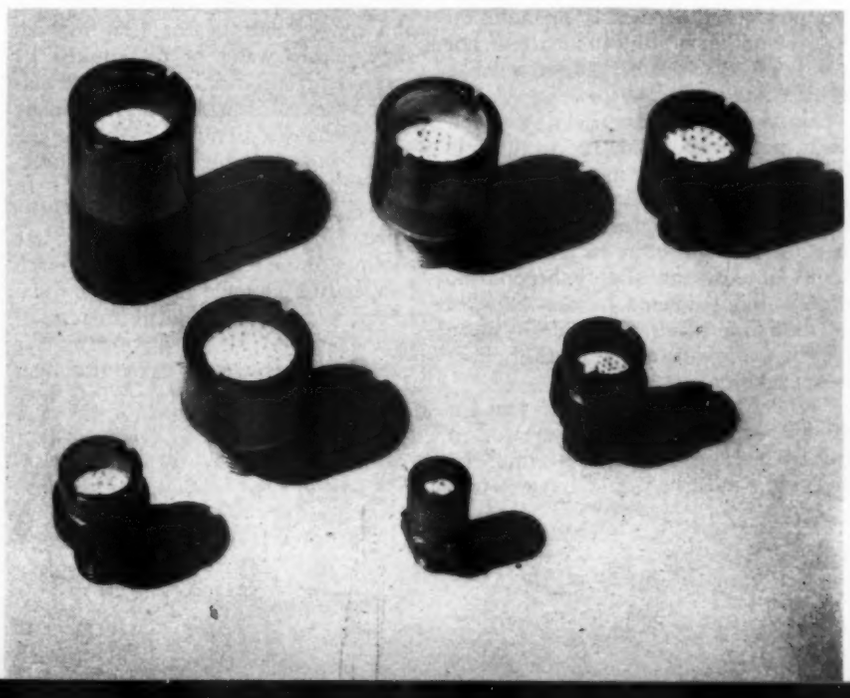
Heat Is Concentrated

Of the three types of burners described, the most widely used in gas-air flame-hardening to date is the "compacted" or "superheated" variety. Its ability to burn a great deal of fuel in small space and concentrate the heat liberation behind small openings permits precise localization of heat. The haze which may be seen beyond the white-hot outlet slots of the burners, Fig. 1, is not flame in the true sense—it is, more accurately, a high-velocity stream of incandescent products of combustion, uncooled and undiluted by secondary air, and only representing the tail-end of the combustion reaction if any.

This stream is less than $\frac{1}{8}$ in. deep and is only as broad as the outlet slot. It can be made to flare out as in the third burner from the left, to focus to a point as in the round model or to hold the full slot width. When the output of such a burner impinges upon a work piece, an incandescent region, only a few times larger in area than the slot opening, is developed although (at a premixed-gas-and-air pressure of 1 lb. just ahead of the burner) the four illustrated models will deliver, respectively, as much as 45,000, 25,000, 12,500, and 12,000 Btu. per hour.

Such burners are widely applied to gear hardening as shown in Fig. 2. By grouping burners appropriately around the periphery of the rotating gear, even surface heating over the faces of gears up to 4 in. wide by 24 in. in diameter has been achieved. The "compacted" or "superheat" slot-type of burner is especially useful in hardening the teeth of bandsaws, hacksaws, thin section knife edges and skate blades without hardening the main body of the blade or saw. Automotive camshafts are similarly hardened with this burner, where the narrowness of the high-temperature and high-velocity stream of incandescent gases permits heating

Fig. 5—"Distributed" burners are used where sections are too heavy for fast heating with "compacted" tips and where the area to be heated is either too small for "radiant" burners or too irregular to permit "radiant" burner cups to be closely faced toward all points requiring heat. Since their only methods of heat transfer to the work is by flame contact and convection, they are not as efficient in fuel consumption as radiant burners



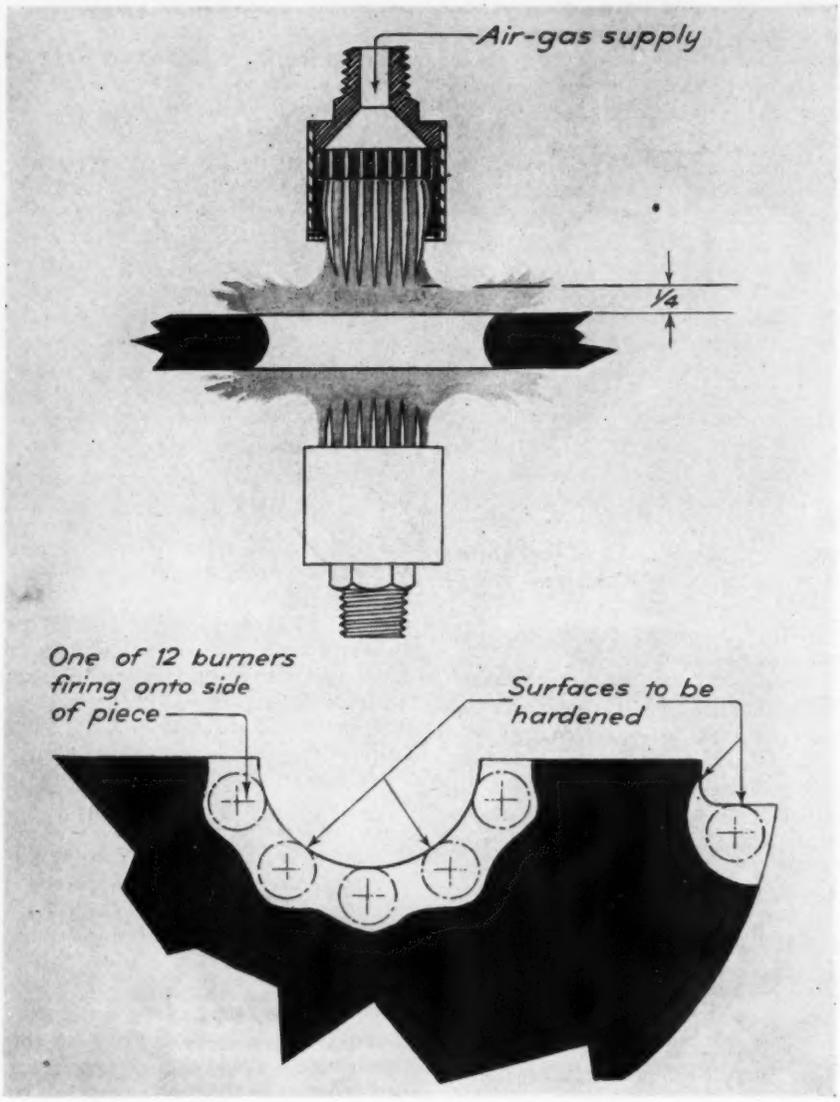


Fig. 6—The above sketch illustrates the use of "distributed" type burners for hardening to bearing surfaces on a 1-in. thick steel part. The burners impinge on either side of the piece adjacent to the surface to be hardened. The centers of the burners are placed between the cold metal mass and the edge to be brought to quenching temperature

of the cam face only, without heating the shaft.

If the mass of the metal part is great in the immediate vicinity of the surface to be hardened, "compacted" combustion is not always the most desirable. The cold metal mass, in such a case, tends so rapidly to steal heat (by conduction) away from the localized area under heat, that it is often wiser to use the "radiant" or the "distributed" type of combustion.

The "radiant" type of combustion, shown in Fig. 3, is generally the speediest and most effective in hardening the surfaces of heavy sections. This speed is accounted for by the proximity of a large radiating surface at a black-body temperature almost double that of the temperature it is desired to achieve on the piece before quenching; this radiant component of the heat is in addition to the familiar heating influence of hot (and even somewhat "compacted") combustion products.

Fig. 4 illustrates a typical application with the burner closely facing the side of a metal section 1 in. thick. Notice that the ideal heat-line (limit of incandescent region) inside the piece is roughly parallel to the surface, and extends laterally only slightly beyond the circular limit defined by the diameter of the burner itself. This ideal can be closely approximated by careful radiant burner design.

Wherever the area to be hardened is commensurate with the cup area of an available radiant-refractory burner (3 in., 5 in., and 6½ in. in diameter) or a multiple thereof, the fastest (the most thin-skinned) heating can be attained with "radiant" combustion set-ups. Hexagonal block assemblies such as shown in Fig. 3 (bottom) permit closest spacing of radiant cups to cover large areas.

"Distributed" combustion is valuable in gas-air flame-hardening or flame-annealing operations where (1) sections are too heavy for fast heating by highly "compacted" methods and also (2) the area to be impinged upon is either too small for available "radiant" burner diameters or too irregular in contour to permit "radiant" burner cups to be closely faced toward all points requiring heat.

Fig. 6 illustrates an interesting technique of application to the hardening of two bearing faces of a steel part 1-in. thick. In this case, the burners do not impinge upon the surface to be hardened, but rather, upon either side of the piece adjacent thereto. The lower half of Fig. 6 shows how the six burners on one side are situated. The theory in this case is that if the burners were to impinge directly upon the faces to be hardened the heat-robbing effect of the metal mass would be so great that operation would be inefficient. With burners situated as shown—their center lines being actually between the cold metal mass and the edge to be brought to quenching temperatures—heat flows to the surface to be hardened from the main body of the piece, and because of the insulating effect of the air at the face to be hardened, concentrates where desired. By and large, it is possible to burn the most fuel over an area ranging from ¾ to 1½ in. wide with the "distributed" combustion burner—although the thermal efficiency of the heating is not so great as with "compacted" or "radiant" combustion.

Almost as vital as the heating method used in flame-hardening work, is the quench employed. Depending upon the steel used, the hardness required and the contour of the heat-line desired, either water or oil applied by spray, agitated-immersion or a combination thereof, may be used. In many cases, where it is not desirable to develop full possible hardness, time-quenching methods are employed. In time-quenching, the removal of the piece from quench before complete cooling, or the regulation of the quench temperature at some higher-than-usual figure, permits a regulated amount of heat (retained in the piece after the quench is complete) to draw or temper the hardness on the surface.

The second installment of this series will appear in an early number.

NYA Trains Welders

All NYA shops are organized along industrial lines, with modern industrial production methods used wherever possible. The young people, whose ages range from 17 to 24 years, are employed 160 hr. a month, for which they receive a small wage

BY JOHN E. RYCKMAN, NATIONAL YOUTH ADMINISTRATION FOR ILLINOIS

EMPLOYERS who have been scouring employment lists for qualified welders are finding that the National Youth Administration offers at least a partial solution for their labor problems. This agency has trained and given work experience in welding to thousands of young men and women in the past few years.

Today there are 8,000 youths getting welding experience in NYA shops scattered over the nation. The turnover as trainees move into private employment is such that more than 16,000 will gain work experience during the course of a year. In a number of instances, NYA projects offering experience in welding have been located adjacent to large ship yards and aircraft plants. For example, projects are to be found adjacent to shipyards in Wilmington, N. C., Port Arthur, Texas, and Seattle, Wash., all of which are regularly feeding workers into the nearby yards. The importance of this contribution to national defense was emphasized by the recent announcement that 200 former NYA youth had participated in the building of the 8,000-ton cargo vessel *Zebulon Vance*, first of its kind to be launched at the Wilmington yards.

The training of welders is but a portion of the nation-wide NYA defense training program, which is currently employing 200,000 young men and women. Emphasis is being given to the preparation of workers for such key industries as the manufacture of machinery and machine tools, aircraft, ships and ordnance equipment. Employers find as a general rule that people with this experience require less time in breaking in on a job. The trainees know what it means to punch a time clock, to observe safety rules, and to care properly for tools and equipment.

During the past 12 months, 430,000 young men and women with this experience obtained jobs in private industries. Some of them were placed in jobs for which they were given specific preparation, including 7,000 in the aircraft industry, 2,000 in shipyards, 3,000 as machine tool operators, and 5,700 in electrical and machinery plants.

Another achievement of the NYA program has been the tapping of an unused source of labor supply through its resident center plan. The resident centers, where youth live and work at the job site, are now giving employment and training to more than 36,000 young men and women. These are youth from rural areas or from small communities where vocational training facilities are not available.

Since the rapid expansion of defense industry has created shortages of skilled and semi-skilled labor in a number of areas, the National Youth Administration has instituted a plan of interstate transfer to enable capable young workers to go from areas where there is a labor surplus to those regions where labor stringencies exist. This plan was begun on an experimental basis several months ago, when NYA employees in Kansas, Oklahoma, Arkansas, and Mississippi were sent to an NYA center in Nepaug, Conn., given a short intensified period of training and placed in jobs in defense industries. Employers in the Connecticut River Valley were enthusiastic over the results of the experiment. Since that time similar plans have been inaugurated with focal points at such industrial centers as Baltimore, Md., San Diego, Calif., and Seattle, Wash.

In developing its training and work experience program, the National Youth Administration has cooperated with industry and business. In order to meet the needs of industry and youth, advisory committees of local citizens have been set up in 1,500 communities where NYA projects are in operation. Business and industry is represented on each of these advisory groups with more than 2,000 business and industrial leaders throughout the nation generously contributing their time.

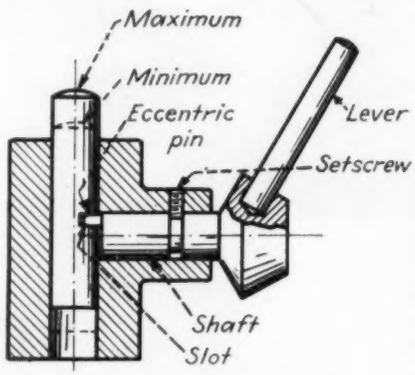
Jig and Fixture Details—IV

BY JOHN G. JERGENS, CLEVELAND PNEUMATIC TOOL COMPANY

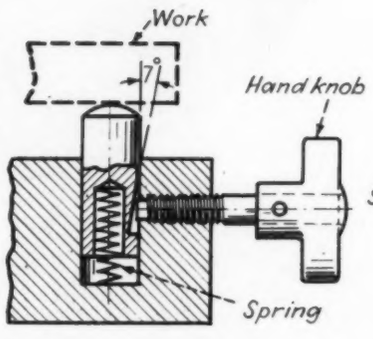
THE DETAILS illustrated on these pages include several forms of jacks or work supports which can be incorporated in jig and fixture design. Each design may show several distinctive features. Thus on a particular application it might be desirable to use the dust cover from one of these drawings, the spring arrangement from a second and the lock from a third.

Vise jaws intended to hold several parts simultaneously are shown as well as a quick-acting nut and an auxiliary leg for drill jigs that makes drilling at two different angles possible.

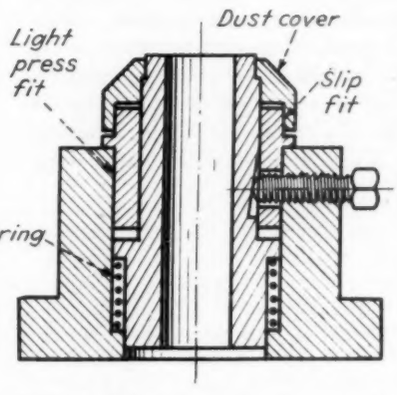
These drawings conclude this series of details applicable to jigs and fixtures.



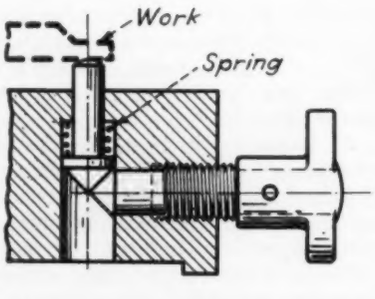
The vertical pin of this support can be raised or lowered by turning the lever, which has a small eccentric mounted in the end of the shaft



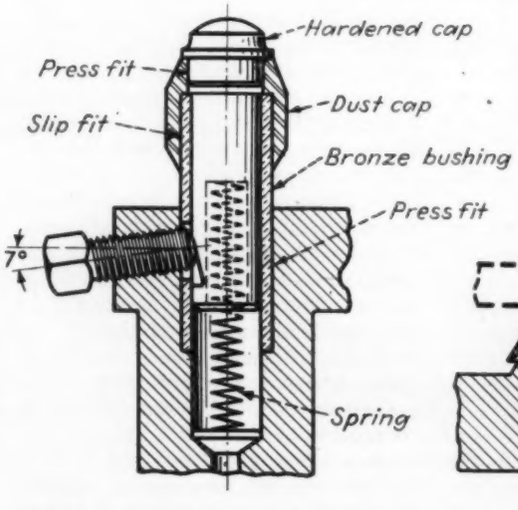
This simple form of the spring jack is equipped with a hand knob which is used to lock the pin in the proper position under the work



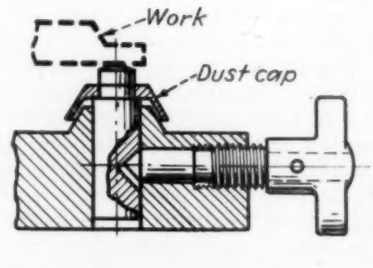
The lock of this work support is wrench operated. A dust cover, which is a slip fit over the outside of the bushing, protects the sliding surfaces



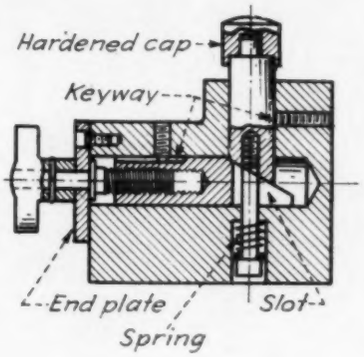
This cone-type support jack is raised by the hand knob. The spring serves to assure lowering of the pin when the hand knob is loosened



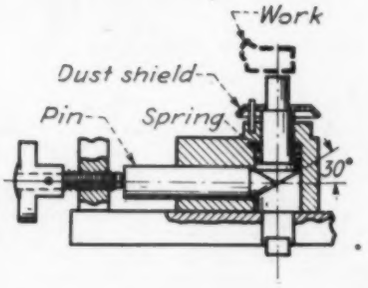
For heavy work this spring jack has a hardened cap. The screw is placed at an angle for more positive locking. The dust cap is close fitting



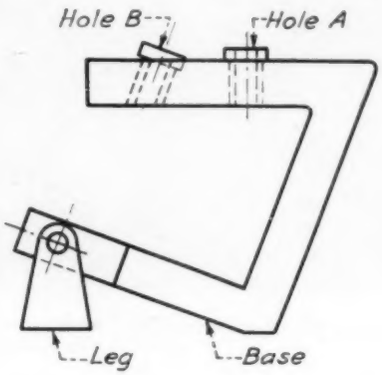
Another form of the cone-type support jack has the horizontal pin fitted into the side of the vertical one. A dust cap is illustrated



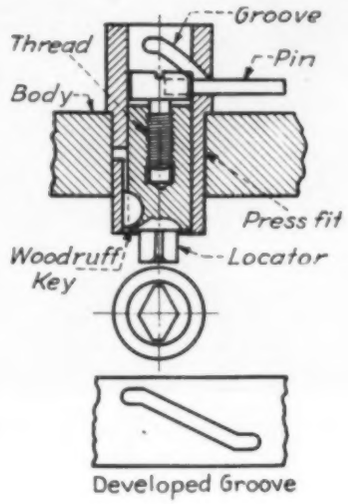
The screw-operated wedge of this support jack has a slot cut in the end through which a bolt can pass to the spring below the wedge



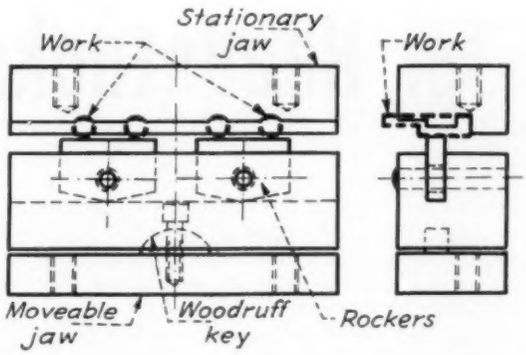
The hand-operated screw of this jack operates against a pin which has a cone end that raises the supporting pin against work as screw is turned



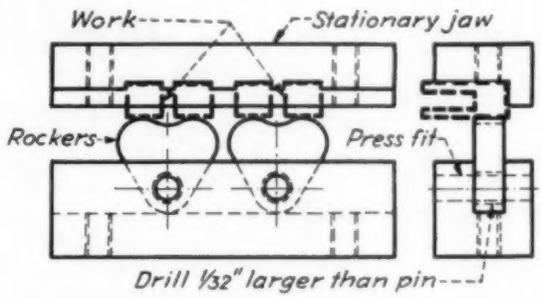
This locating slide has a pin which fits through a groove in the sleeve. Moving the pin along this groove shifts position of the locator



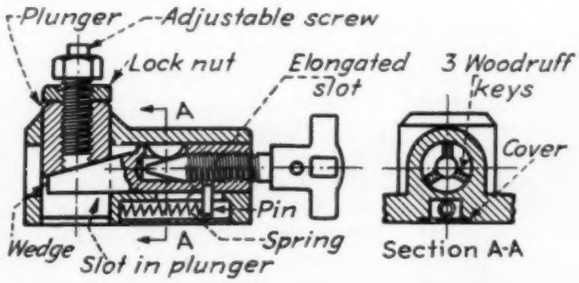
An auxiliary leg on this drill jig can be slipped into position shown for drilling hole *A*. The jig rests on the base to bring hole *B* into drilling position



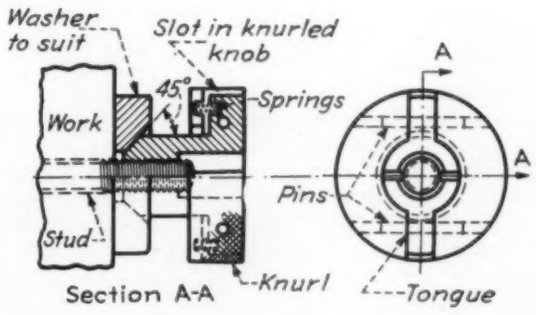
Parts of varying size can be held in these vise jaws designed for milling four round pieces. The double-rocker action makes the vise very flexible



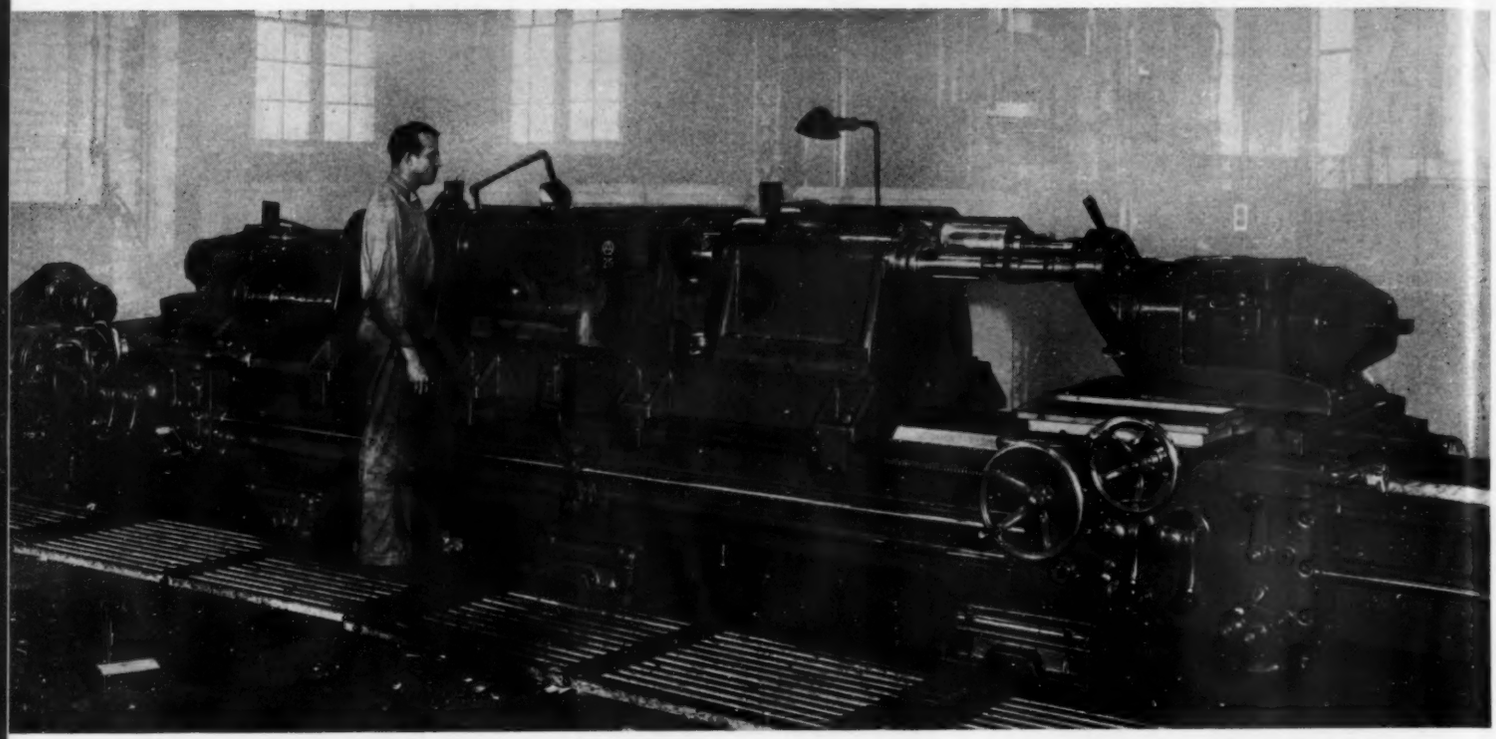
Parts of uniform size held to close tolerances can be clamped at the same time in this type of vise jaw. These jaws have tapped holes to suit the vise



The wedge slides freely to raise or lower the plunger of this jack. Three woodruff keys lock the wedge in any position when the screw is tightened



This quick-acting nut is slipped over the stud until it strikes the washer, then tightened by a single turn. The knurled knob holds the two halves of the nut together



A special machine, made up largely of standard lathe parts, is used to bore both ends of a headstock simultaneously

Double-End Machine for Headstocks

Axelson saves boring time by an arrangement which completes all holes in a single lathe set-up

HIGH PRODUCTION schedules have stimulated the adoption of some novel operating improvements by the Axelson Manufacturing Company, Pacific Coast lathe manufacturer. One of these is the use of a machine for boring lathe headstocks by means of which all the major bearing holes can be completed in one setting.

The machine for performing this work, while of special design, is built of many standard machine parts. For instance, it uses a standard 32-in. lathe bed, a gear box and two regulation carriages. Other parts, including the boring heads and a portion of the feed mechanism, were made expressly for this machine.

Before reaching the boring operation, the headstock is semi-finish planed on the bottom to provide a flat supporting surface and a female V which locates it in the boring fixture and also on its own bed in the final assembly. An extra bracket, cast integral with the headstock, is planed at the same time to give additional support during the boring operation. The work is done on a 48-in. Gray planer with the headstocks ganged upside down on suitable holding fixtures. The front pads are semi-finish planed in this first set-up.

With the front face on the table of a Giddings & Lewis horizontal boring machine and the bottom clamped against an angle plate, the top of the headstock and all inside surfaces are roughed out leaving 0.30 in. of stock. In a second set-up the bolt slots and the tops of the bolt slots are machined.

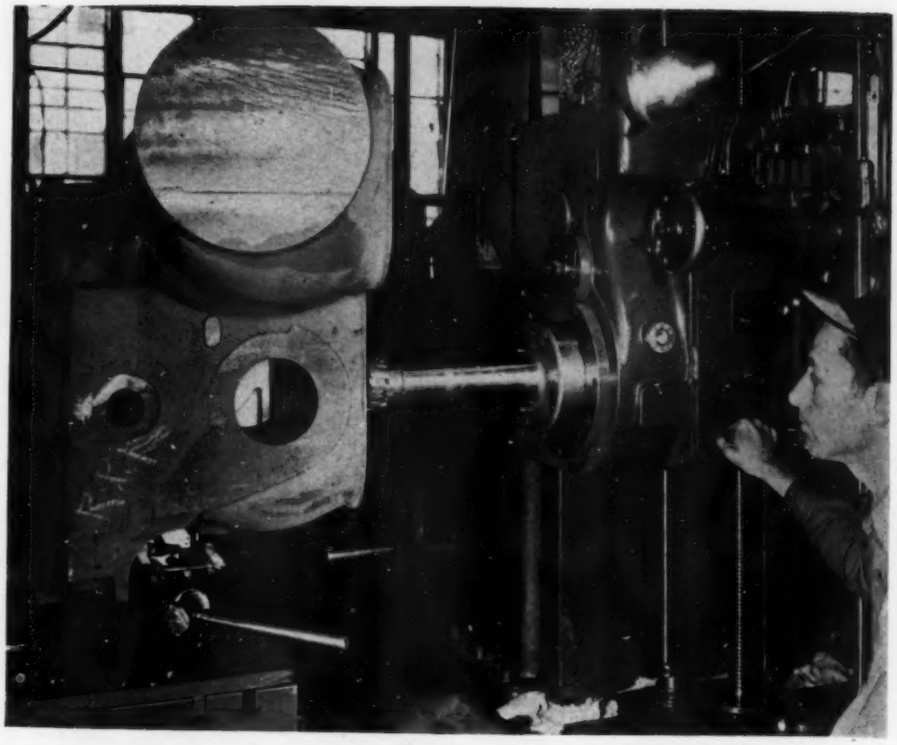
The headstock is then returned to the planer where the bottom and front faces are finished; the casting is lined up from the previously machined surfaces.

A Cincinnati Bickford radial drills and back counterbores the bed mounting holes with the use of a drill jig. The same jig is used for the corresponding holes in the lathe bed. It has a male V at one side and a female V on the other in order to mate with both castings.

A fixture on the Axelson special boring machine has a V which mates with that in the headstock. When the headstock is bolted down, just as it is when assembled on its own bed, it is located between two boring heads, each of which is supported on one of the lathe rests. The feed to the boring heads is obtained through the regular lathe feed shaft and standard carriage aprons. The feed shaft is driven by a 2-hp. geared motor through a tumbler gear box which provides a range of feeds in the usual manner.

Each boring head consists of two units: a driving mechanism and a bar support. The support at the faceplate end carries two boring bars and that at the opposite end three bars. One of the bars at the motor end of the headstock drives four auxiliary boring spindles. All bars revolve in extra heavy bushings to give them rigid support.

The bars are driven by two 5-hp. motors, one on each carriage, through standard four-speed transmission units which give ratios of 1:1, 2:1, 3:1 and 4:1. Any ratio may be selected by means of a single-lever shift in order to obtain the desired boring speed.



All faces, inside and out, that are not completed in planing, are machined on a horizontal boring, milling and drilling machine

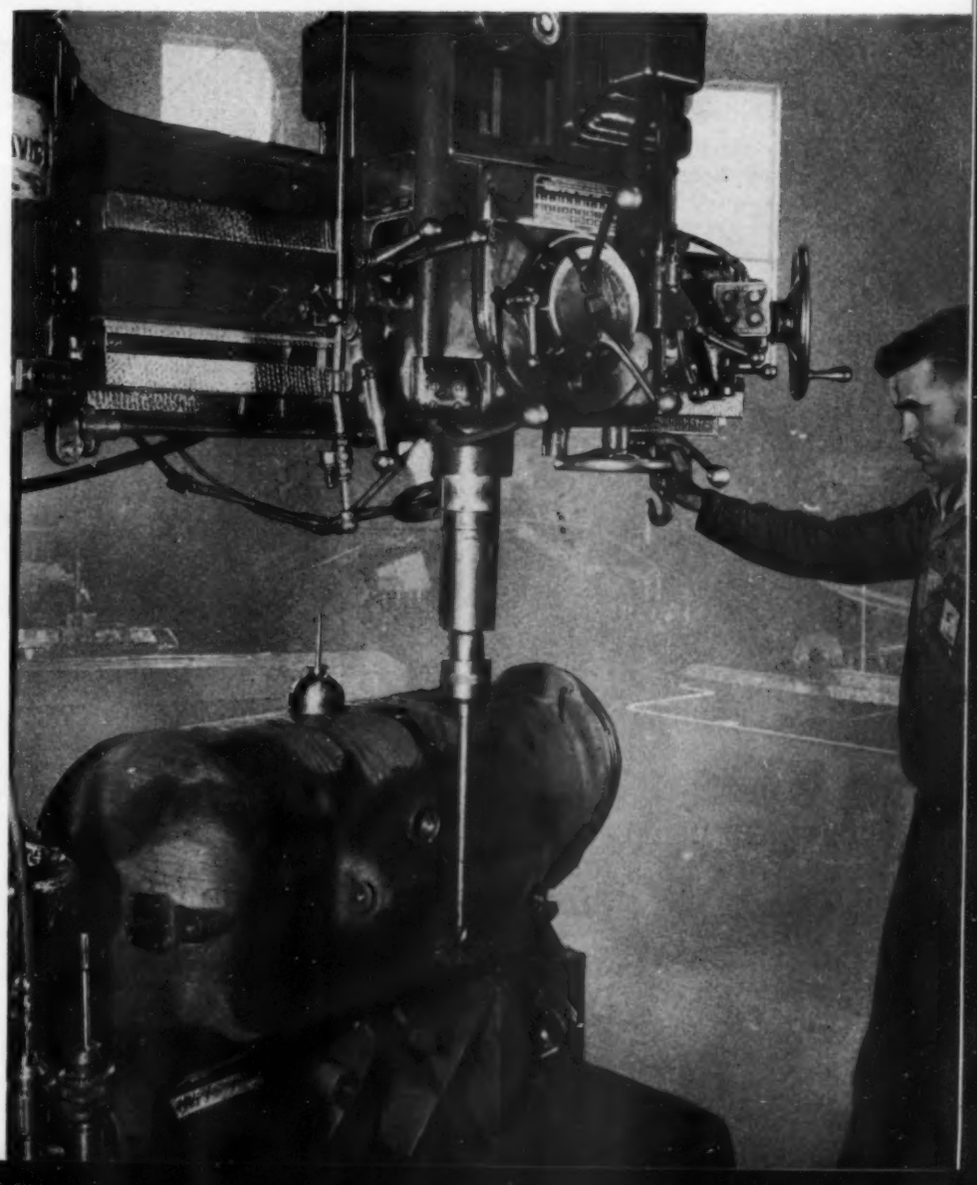
bed of the machine is mounted on hardened screws with spherical ends which fit into hardened concave floor plates. Adjustment of these screws affords a convenient means of keeping the machine properly aligned, a method of leveling which is standard on Axelson lathes.

Headstock castings are made in Axelson's own foundry. After snagging they are sandblasted for further cleaning and normalized at 1,200 F. in a cycle that takes about twelve hours. Castings too large for the company's heat-treating furnaces are sent outside for normalizing in a car-bottom furnace owned by a neighboring plant. Normalizing removes cooling stresses and avoids distortion after the casting has been machined.

The surfaces at the ends of the headstock are then finish machined in the horizontal boring machine. Again the bottom V is used as a point of location. All other finished surfaces, top, bottom and side, that were not completed in the planer set-up are also done in this machine.

The headstock is drilled on all six sides in the radial drilling machine. For the larger headstocks a pit in the

A heavy radial drill takes care of holes in six different directions. Drilling the conduit clearance, shown at the right, is one of the few steps not using a jig



The drive spindles are not in line with any of the boring bars but in the geometric centers of circles passing through the centers of two bars at the faceplate end and the three bars at the motor end. A swinging arm is mounted on each driving head and connects the driving spindle through a chain of gears to a short quill at a radius that enables it to be engaged successively with any boring bar the operator wishes.

Both ends of the headstock are bored simultaneously, but only one hole at a time in each end except for one bar at the motor end which bores four of the smaller holes at one time.

Once the work-piece has been put in place, neither it nor the bars need further adjustment. The hole centers are taken care of in the fixture. So accurately has this device been built that the height of the holes above the bed and their distance from each other is held within 0.001 in.

Cemented-carbide boring tools are used, which again increases the time saving on this operation. Each tool bit is adjustable by means of a micrometer built into the boring bar. The

floor permits locating the work at a height convenient for the operator.

Headstocks are set on low worktables for installing the gears and shafts. The castings are moved from station to station with specified steps planned for each.

Two noteworthy devices employed by Axelson reduce lost motion in assembly. A portable rack holds all the parts for a given number of assemblies, usually about six. The rack is loaded in the stockroom to which all finished machine parts go after inspection. It contains compartments on each of which is a metal tag giving a part number. With the part numbers before him, the stockroom attendant cannot go wrong in supplying a complete set of correct parts.

The racks can be carried by a lift truck directly to the proper location in the assembly department. They are used for gear boxes, aprons and carriages as well as headstocks.

The second time-saving device is a portable tool box which hangs directly over the headstock casting during assembly. It consists merely of a wooden box with two steel straps which are hooked to hang over the side wall of the casting. Use of this arrangement keeps the tools handy at all times and easy to carry to the next headstock.

A portable toolbox hung on the side of the headstock saves motions

Assembly is speeded by a parts rack that can be loaded in the stockroom and delivered on a lift truck. Two such racks carry all parts for six headstock assemblies

Smoothing the Scrap Cycle

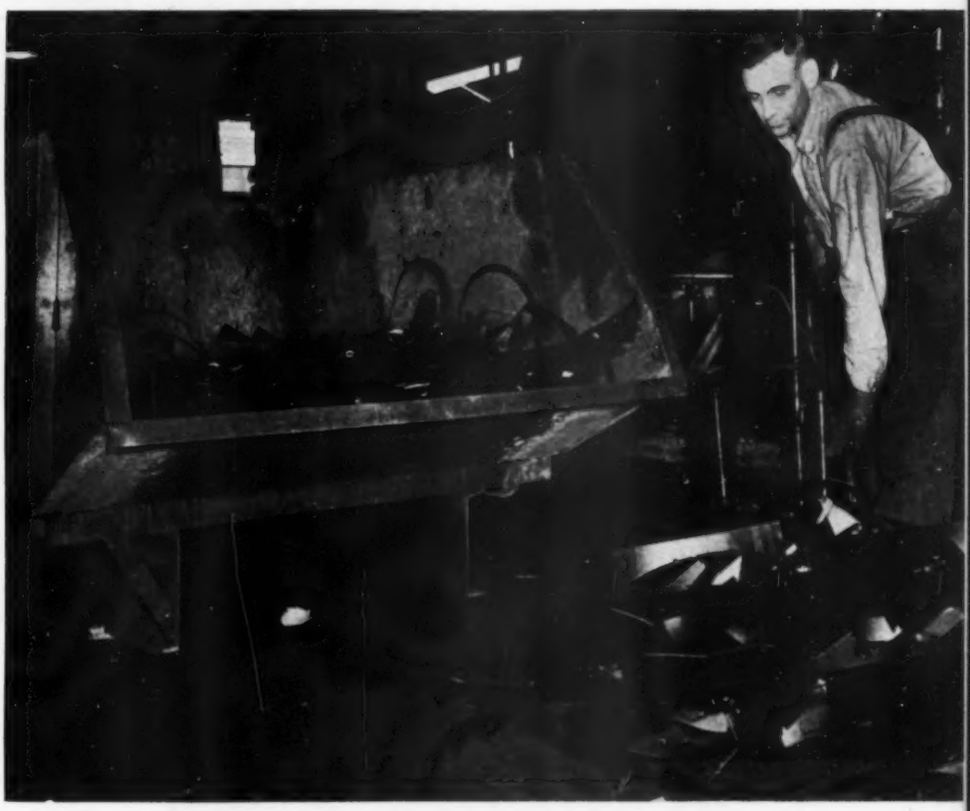
BY JOHN L. LARE, GENERAL ELECTRIC COMPANY

G. E. has a salvage system that reduces the handling time for many kinds of surplus materials

DEMOUNTABLE dump-truck bodies carry scrap directly from manufacturing areas to distant scrap pits and balers with a minimum of handling at a Midwestern General Electric plant. In this system, dump bodies are located near machines in the shop and scrap is shoveled into them. When full, these bodies are picked up with standard platform lift trucks and taken from the manufacturing floor to permanent stilts outside the building.

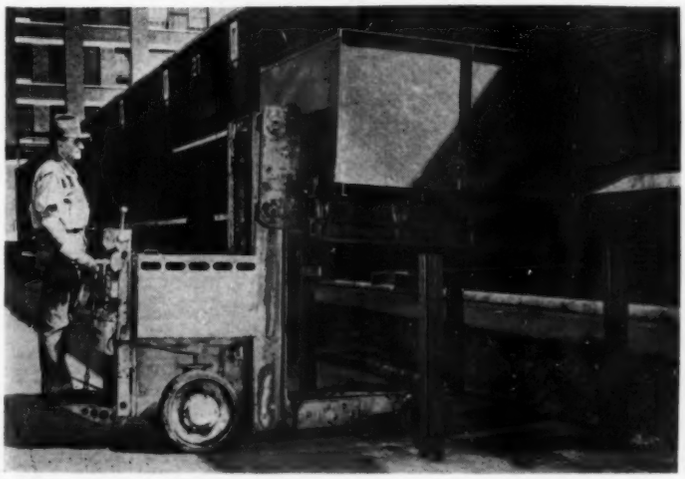
Later, the full bodies are picked up from the stilts by standard dump trucks without any assistance from the crane or other operators. It is not even necessary for the driver to get out of the cab to pick up or deposit a load. Each unit in this system operates independent of the other, eliminating waiting time in loading or unloading.

This method of handling is being used for loose steel punchings, baling iron, steel turnings, borings, rubbish and other scrap from single and multi-story buildings, displacing side-dump four-wheel trailers which were difficult to handle and couple.



Truck dump bodies are placed near machines in the shop, and scrap is shoveled into them. Separate dump bodies are used for different types of scrap

When the dump bodies have been filled with scrap, they are moved by standard platform lift trucks to stilts outside the manufacturing area. Bodies which have been emptied and returned to these stilts are picked up by the same trucks for return to the shop



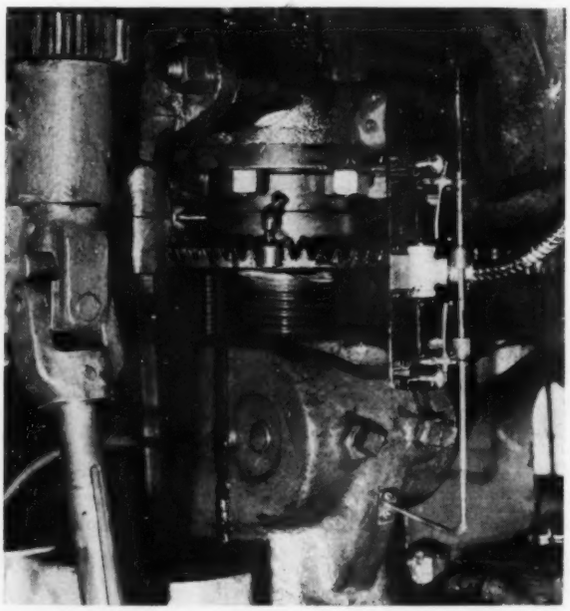
Gasoline trucks employed for moving the dump bodies between the stilts alongside the manufacturing department and the scrap salvage department are fitted with tilting mechanisms for dumping the loads. It is not necessary for driver to leave cab to pick up a load

IDEAS FROM PRACTICAL MEN

Punch Press Ram Adjustment Limit Switch

BY H. W. DAILEY
Westinghouse Electric & Manufacturing Co.

For use on large punch presses which are equipped with motor drive for raising and lowering the ram, an adjustment limit switch has been devised which prevents the die setter from jamming the pitman screws or from running them out too far which would cause bending under a heavy load. This limit switch is used when changing the ram adjustment to suit the various dies used in large presses.



A limit switch connected to the motor drive of this large punch press prevents damage to the pitman screws

Two switches are connected into the electrical circuit of the adjusting motor. These switches are operated by stops mounted on a rod which is fastened to the connector pitman.

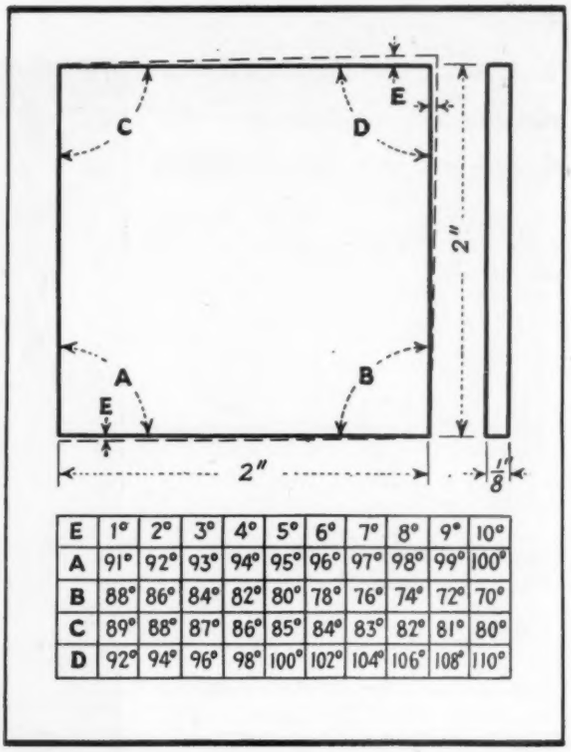
In operation, considerable expense in damaged pitman screws has been avoided by this automatic control.

Angle Blocks for Tool and Die Work

BY C. F. FITZ

In tool and die work one is constantly faced with the problem of working with angles and it is often difficult to layout and record these angles as well as set up work with the standard tools made for this purpose.

To save time and to increase accuracy we made several sets of the angle blocks as shown on the drawing. These blocks are made from Brown & Sharpe flat tool steel, properly heat-treated, ground and lapped to the specified angles. The blocks are etched with an electrical pencil to indicate the various degrees of the angles of each corner.



E	1°	2°	3°	4°	5°	6°	7°	8°	9°	10°
A	91°	92°	93°	94°	95°	96°	97°	98°	99°	100°
B	88°	86°	84°	82°	80°	78°	76°	74°	72°	70°
C	89°	88°	87°	86°	85°	84°	83°	82°	81°	80°
D	92°	94°	96°	98°	100°	102°	104°	106°	108°	110°

Angle blocks made up like this one can be used to good advantage in tool and die work

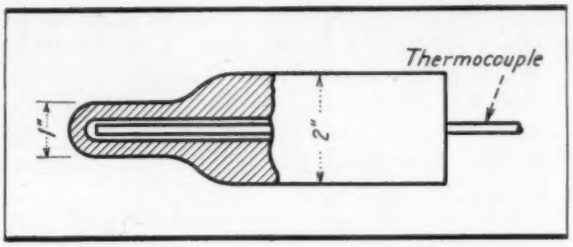
The table shows the various angles that can be obtained by varying the value of *E* on each block of a set.

Longer Life From Salt-Bath Electrodes

BY R. L. PEGRAM

Salt-bath electrodes, which are made of chrome iron, are difficult for even war producers to get. After about a week's use the electrode is eaten away at the salt line.

In conventional practice some 14 in. of electrode might be cut off and thrown away. To conserve alloy, the heat-treat foreman of an auto plant has developed an electrode shape that provides extra thickness at the salt line for additional life, and minimizes the amount of metal that surrounds the thermocouple end. The small diameter moreover promotes good heat-transfer



This salt-bath electrode has a larger diameter at the salt line where it is eaten away. This arrangement keeps the end small for accurate thermocouple reading and adds to the life of the electrode

conditions so that a true thermocouple reading is secured.

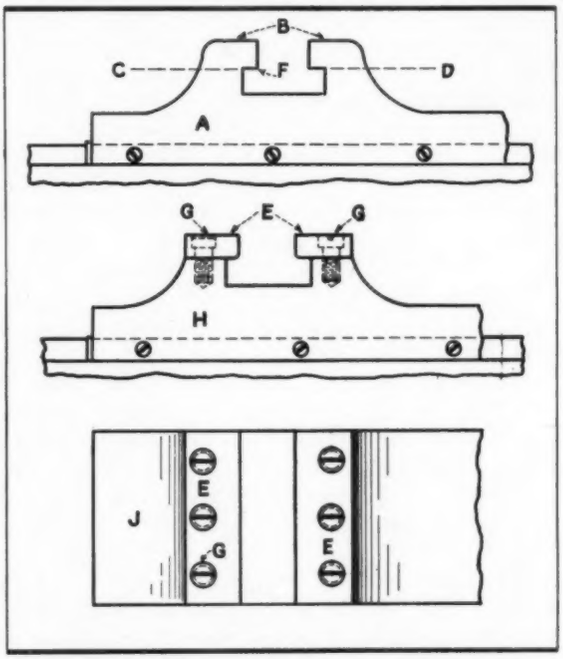
When the new electrode is partially eaten away at the salt line, it is upset to restore the original diameter. This shortens the electrode 3 in. approximately, instead of the 14 in. that was originally cut off. When electrodes become too short for further use, they are forged into thermocouple tubes.

Preventing Worn Toolrests

BY GEORGE J. MURDOCK

L. F. Southwick (*AM*—Vol. 86, page 299) and F. J. Steidlmayer (*AM*—Vol. 86, page 511) have described methods for correcting worn toolrests but have not offered a remedy.

The wear is caused by minute particles of steel which become embedded in the cast iron and cause wear whenever the toolpost is moved. The problem can be solved by removing the toolpost holder *A* from the slide rest and locating it on two parallels of a milling machine. The lips *B* are milled off along the line *CD*. Two rectangular pieces of tool steel *E* are then made with counterbored holes to receive the filister head screws *G*. These are hardened and ground on top and bottom *F* so as to be of the same thickness as the lips that were milled off.



Worn toolrests may be avoided by milling off lips *B* and replacing them with hardened steel lips *E*

The heads of the screws are made to be slightly below flush with the tops of the lips. The screw heads are case hardened.

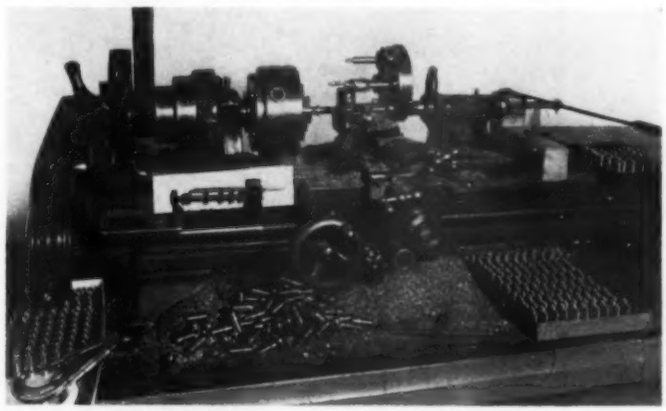
With the new hardened steel wearing surfaces the toolrest will look like *H* from the side, while the top will be similar to *J*. Dressing off the worn surface is a makeshift that will weaken the lips, one or the other of which may crack from the strain of tightening the tool in the post. This method should give many years of satisfactory service.

Bench Lathe Converted for Turret Work

BY F. S. McGIBBON

In an effort to get out more production on a war contract the bench lathe shown in the illustration was equipped with several additions which give it nearly the production of a turret lathe.

The carriage stop at the left is clamped to the lathe bed. It is made of cold rolled steel $\frac{3}{8}$ in. in dia. and 5 in. long, threaded the entire length and supported at both ends. On this rod are six disks which can be moved to any required position. Above the disks is a $\frac{1}{4}$ in. square rod which is forged flat at one end, bent at one end and slotted so that it will drop down over the screw in front of any one of the disks desired. This rod is held in a slot in the forward screw support between two pins so that it is possible to lift the end in moving it from one disk to another. A flat spring is placed under the square rod, to keep it in place when it is drawn out past the center of gravity.



The addition of a carriage stop, a revolving toolpost, a tailstock turret and the substitution of a hand lever for the hand wheel on the tailstock spindle give this bench lathe production nearly equal that of a turret lathe

The revolving toolpost will hold four bits. It can

be revolved in one direction only. A ratchet pin locks it as each tool comes into position. A hand lever is provided to lock it in the cutting position.

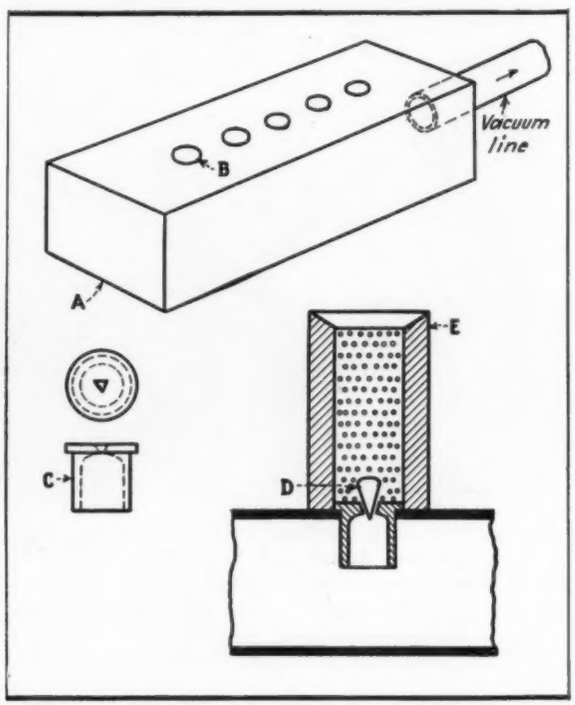
The tailstock turret holds six tools and is self-locking as each tool comes into position. This turret is connected to the tailstock spindle by a No. 2 Morse taper. The handwheel was removed from the tailstock spindle, and an extension was made to connect to a hand lever, which is supported by a hard wood block bolted to the lathe bed.

Setting Diamonds in Wheel-Dressing Tools

BY R. T. JAMESON

War production requires much more grinding than do peacetime operations, in the experience of the automobile industry. In 1941, a certain major passenger-car producer used 923 carats of diamonds for wheel-dressing. But in the first four months of 1942, one war activity of this company alone consumed nearly 700 carats, and with production still mounting rapidly, still greater use is expected.

To cope with expanding requirements for wheel-



Diamond splinters are positioned for mounting by placing them in triangular openings of vacuum box A. A tool shank is cast around the diamond to produce the holder

dressing tools, the heat-treat foreman devised a method of positioning the diamond by vacuum, while casting a tool shank around the stone, using Everdur 1000 brazing alloy. Chamber *A*, connected to a vacuum line, has a number of holes *B* in the top surface to take close-fitting plugs *C* in which the diamonds are positioned. These plugs are made with various sizes of three-cornered holes, to accommodate diamond splinters of different sizes. It is essential to select the plug so that a certain amount of air leakage occurs past the diamond, principally to cause the splinter to stand vertically, and also to clean out particles of foreign matter which might otherwise collect in the opening.

To produce the diamond holder, the selected stone *D* is placed vertically in the proper plug, and the plug is inserted in any vacuum box hole. Next a removable mold *E* is placed over the diamond positioner, and molten brazing alloy *F* is poured to fill the cavity, producing the dresser shank. With a minimum of machining the completed tool is made ready for use at the grinding machine.

Padlocking a Punch Press

BY FRED C. COLVIN

To secure best results in airplane sheet metal work it is necessary to have even plain round punches and dies kept on the class of work for which they are designed, and ground. This is not always easy, especially when the shop is working two or more shifts.

In one shop, where the Weiderman multiple dial punch is used extensively, an easy method for preventing improper or unauthorized use of the machine has been developed. Bands of sheet metal, wide enough to cover the opening between the upper and lower plate have been made. They are provided with a staple in one end to fit a slot in the other when the band is put around the machine. When the operator is through for the day, he puts the band around the machine, slips the staple through the slot and padlocks the band in place. The press can thus only be used by those authorized to do so.

Why Mandrels Wear Unevenly

BY CHARLES S. BEACH

It was noticed in one shop that several standard hardened mandrels were not true and so they were tested to see how much they were out. In testing it was noticed that the flat for the dog screw was in nearly the same relation to the high side in each instance and that the small end had run out much more than the large end.

This would seem to indicate that this wear is caused by the action of the driving dog which must always be placed in the same position because of the single flat provided for it. As most work is ordinarily done near the small end of the mandrel it would be expected that more irregularity would develop at that end.

An improvement in the construction of mandrels which would add to their life would seem to be made by equipping them with three flats on the large end and two on the small end. This would make more even wear possible. If the size were stamped on one of the flats it would be helpful.

The Working of HIGH-NICKEL ALLOYS

NICKEL, a white, malleable, non-corrodible metal, has mechanical properties similar to those of mild steel, but is much superior in its resistance to corrosion. Nickel ranks ninth among the metals in world consumption; but its importance is greater than this ranking suggests. As an alloying element, it enhances the useful properties of many times its own weight of ferrous and non-ferrous alloys.

A number of important nickel-base alloys, as well as commercially-pure nickel, have unusual resistance to corrosive agents of varying types and concentrations. They are employed for the manufacture of parts for a wide variety of products which must have high mechanical properties as well as excellent corrosion resistance. These high-nickel alloys, and accepted methods of working them in the shop, are discussed on the following pages.

MATERIALS AVAILABLE

Nickel—Commercially-pure wrought nickel is about 99.40 percent pure, while electrolytically-refined nickel has a purity of approximately 99.95 percent. Wrought nickel contains fractional percentages of copper, iron, manganese, carbon and silicon, as well as a trace of sulphur. It is a strong, tough, rustproof metal which combines excellent mechanical properties with good corrosion resistance. Its strength is retained to a high degree at elevated temperatures, and at sub-zero temperatures, its strength, ductility and toughness are maintained. The strength and hardness of nickel can be increased by cold working, but not by heat treatment. It is fabricated readily, and may be joined by all of the usual methods.

Low-Carbon Nickel—This metal, commonly known as "carbon-free nickel," has about the same nominal composition as nickel. The carbon content is kept very low—0.01 to 0.02 percent. It is produced chiefly as cold-rolled sheet or strip. This low carbon grade is softer than nickel, and does not work harden as rapidly. It is sometimes preferred for making spun, drawn, or stamped articles. The material is recommended for salt-bath containers for heat-treating aluminum alloy parts.

Nickel-Manganese Alloys — The presence of manganese in high nickel alloys reduces the susceptibility to attack by sulphur gases, which accounts for the use of nickel-manganese alloys where this factor is important. The principal commercial alloy of this group, "D" Nickel, contains approximately 4.5 percent of manganese.

"Z" Nickel—This strong, corrosion-resisting alloy made by adding aluminum to nickel can be hardened by heat-treatment (aging) to Rockwell C 30-45. At these hardness levels, "Z" Nickel is 2½ to 4 times stronger than structural carbon steel. Its general resistance to corrosion is of the same order as that of nickel, and its choice over the latter usually is based primarily on mechanical requirements. This alloy work hardens much more rapidly than does nickel and it can be thermally hardened after fabrication without destroying the effect of the cold work. Maximum strengths are obtained by cold working and then heat-treating.

Monel—This is a copper-nickel alloy containing 63 to 70 percent nickel and up to 30 percent copper, together with small amounts of iron and manganese. Monel is more resistant than nickel under reducing conditions, and more resistant than copper under oxidizing conditions—as a net result, it is, in general, more resistant to corrosion than either of its principal constituents. The alloy is readily worked, responding to most fabricating operations in about the same manner as steel of a similar yield strength. It can be machined, welded, brazed, soldered, forged, drawn, spun and annealed. Although Monel does not respond to heat-treatment, a wide range in strength can be obtained by cold working.

"R" Monel—This is a free-machining alloy having essentially the same chemical composition, mechanical and physical characteristics as the regular Monel alloy. It has the free-cutting characteristics needed for high-speed automatic machine work, and at the same time provides almost the same corrosion resistance and immunity to rust inherent in Monel. The strength of "R" Monel is equal to the best available steel screw stock. It can be fabricated readily by cold forming operations, but is not recommended for hot forming operations.

"K" Monel—An extra-strong, rustproof, corrosion resisting nickel-copper-aluminum alloy, "K" Monel has the added advantage of being capable of having its hardness and strength increased considerably by heat-treatment. The corrosion resistance of "K" Monel is comparable to that of Monel in organic acids, alkalis, salts, industrial waters, food products, organic compounds and atmospheric oxidation at normal and elevated temperatures; and is superior in aerated ammonia solu-

This section was made possible through the cooperation of the following organizations:

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National Acme Company
National Twist Drill and Tool Company
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Socony-Vacuum Oil Company
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tions, and inferior to Monel in hot dilute sulphuric acid.

"KR" Monel—This recently developed alloy combines free-cutting qualities with the properties of "K" Monel. It is used for screw machine parts that are to be thermally hardened after machining. Physical and mechanical properties are practically the same as those for "K" Monel.

Inconel—An alloy containing about 79 percent nickel, 13 percent chromium and 6 percent iron, Inconel combines the corrosion resistance, strength and toughness of nickel, the basic metal, with the extra resistance to heat and oxidation contributed by chromium. Because of its ability to withstand repeated heating and cooling in the temperature range from 0 to 1600 F. without embrittlement, Inconel is used extensively for exhaust manifolds for airplanes, and for various types of furnace and heat-treating equipment requiring resistance to temperatures up to 2000 F. The alloy is readily welded, brazed, silver soldered, machined, formed, drawn and forged.

High - Nickel Casting Alloys — Monel, "H" Monel, "S" Monel, nickel and Inconel are produced both as sand castings and centrifugal castings. In each of these casting alloys silicon is a necessary alloying element—small amounts of magnesium also are added to improve casting characteristics. Monel, "H" Monel, nickel and Inconel castings are readily machinable in the as-cast conditions. "S" Monel is less machinable in the as-cast condition, but castings made of this alloy can be annealed for machining and then hardness can be restored by age-hardening.

"H" Monel castings, containing 2.75 to 3.25 percent silicon are used for applications where the castings must have good ductility and increased but not maximum hardness. "S" Monel contains about 4 percent of silicon, which hardens it markedly. As-cast "S" Monel is about 320 Brinell.

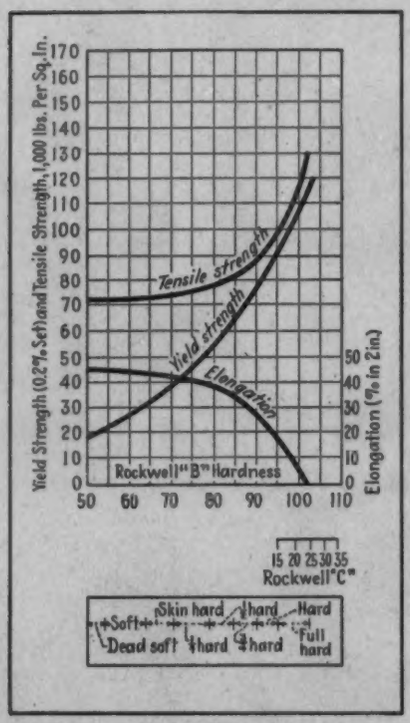
Inconel castings supplement wrought Inconel, and are used under severe corrosive conditions. They are available in a number of alloys containing from 60 to 80 percent nickel and from 13 to 20 percent chromium, with the remainder mostly iron.

Hastelloy Alloys—The Hastelloy alloys consist of four types of nickel-base alloys, referred to as *A, B, C* and *D*. These alloys provide outstanding resistance to corrosion by mineral acids and other corrosive media, and have excellent physical properties. Alloy *A* is a nickel-molybdenum-iron alloy that is readily machinable, makes excellent castings, and can be welded by the oxyactylene, atomic hydrogen or metallic arc processes. Alloy *B* is a nickel-molybdenum-iron alloy similar to alloy *A*, but containing a higher percentage of molybdenum. It is well suited for handling boiling hydrochloric acid and wet hydrochloric acid gas. In physical properties, alloy *B* is similar to alloy *A*, but it has greater mechanical strength, particularly at elevated temperatures.

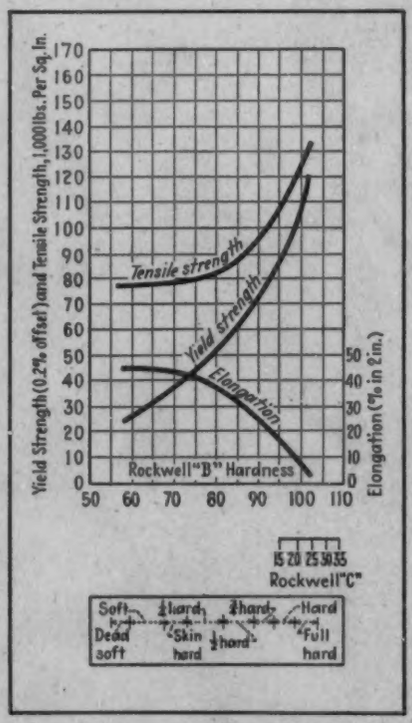
Hastelloy alloys *A* and *B* are austenitic and contain a small proportion of carbides, even when they are cooled rapidly from a high temperature. They are appreciably hardened by cold working, with an increase in yield point and ultimate strength, and a corresponding reduction in ductility. The full - anneal heat-treatment recommended for these alloys softens them and develops their maximum ductility and corrosion resistance.

Alloy *C*, a nickel - molybdenum - chromium-iron alloy, effectively withstands strong oxidizing agents, such as nitric acid, free chlorine, aqueous solutions containing chlorine or hypochlorites, and acid solutions of ferric or cupric salts. This alloy is machinable at moderate speeds and can be welded. It is available in cast form, and as hot rolled sheet or plate. The alloy is not excessively hard, but its structure makes machining—and to an even greater degree, rolling—difficult. It is not practicable to forge alloy *C*, hot or cold. The machinability of alloy *C* castings can be improved by a full anneal heat-treatment, which also results in an increase in both ductility and corrosion resistance.

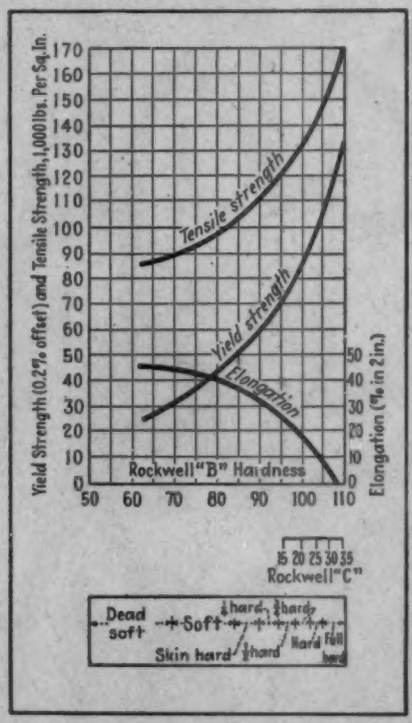
Hastelloy alloy *D* is a cast alloy composed primarily of nickel and silicon, together with small amounts of other



(1) Average tensile properties of nickel sheet and strip



(2) Average tensile properties of Monel sheet and strip



(3) Average tensile properties of Inconel sheet and strip

APPLICATIONS OF TYPICAL NICKEL-BASE ALLOYS

ALLOYS AVAILABLE (Trade Names)	Forms Commonly Available									CHIEF CHARACTERISTICS	TYPICAL APPLICATIONS
	Cold Rolled Sheet & Strip	Cold Drawn Rods & Bars	Seamless Tube & Pipe	Welded Tube & Pipe	Forged Billets & Shapes	Hot Rolled Plate & Sheet	Hot Rolled Rods & Bars	Hot & Cold Rolled Angles	Castings & Cast Fittings		
Nickel	●	●	●	●	●	●	●	●	●	Combines excellent mechanical properties with corrosion resistance that is good generally, and outstanding under many conditions of exposure. Readily fabricated, it can be cold worked, welded, and annealed, but not heat-treated. Retains strength well at high temperatures.	Used to make evaporators, jacketed kettles, heating coils, and other processing equipment for chemical and allied industries. Also used to protect the purity and color of many food products and pharmaceuticals. Electrical contact parts made of nickel withstand arcing.
Low-Carbon Nickel	●	..	..	..	..	..	..	..	..	Has essentially the same nominal composition as nickel, but carbon content is kept very low. Produced chiefly in the forms of cold rolled sheet or strip. Softer than nickel and does not work harden as rapidly. Mechanical properties are lower than for nickel.	Sometimes preferred for production of spun, drawn or stamped articles because of its cold working characteristics. Finds its greatest use in making nickel crucibles or combustion dishes for laboratory use. Such articles must withstand oxidizing furnace atmospheres to 2000 F.
"D" Nickel	..	●	●	..	..	..	●	..	..	Superior to nickel under oxidising sulphurous conditions at elevated temperatures. Mechanical strength greater than that of nickel, both at normal and elevated temperatures. It more nearly approaches that of Monel. Very resistant to electrical sparking.	Used extensively for spark plug electrodes, ignition tubes, and for boiler refractory bolts, particularly in marine boilers. Produced and used chiefly in the forms of rod, wire, tubing and strip.
"Z" Nickel	●	●	..	..	●	..	●	..	..	Heat-treatable alloy having extra strength and hardness. It is magnetic, has good electrical conductivity, and excellent spring properties. General resistance to corrosion of same order as that of nickel. Work hardens more rapidly than nickel.	Used for corrosion resistant springs, current carrying springs that are heavily stressed, marine and automobile radio antennae, diaphragms and similar flexing parts. Also used to make pump parts for handling viscous materials, and to make extrusion dies for plastics.
Monel	●	●	●	●	●	●	●	●	●	A "general purpose" rather than a "specialised" alloy, Monel is a strong, tough, rustproof and corrosion resistant material having many applications throughout industry. Cold-worked, welded and cast forms behave substantially the same under most corrosive conditions.	All types of equipment requiring a rustless, corrosion resisting material — with rigidity, strength and toughness: Valves and pump parts, turbine blades, laundry machines, food service equipment, salt dryers, processing equipment and other industrial and marine parts.
"R" Monel	..	●	..	..	..	..	●	..	..	Free machining grade. Developed for parts to be made on automatic screw machines. Has essentially the same nominal composition as Monel — iron, manganese and sulphur content is slightly higher. Mechanical properties and corrosion resistance are substantially the same.	Bolts, screws, precision parts for valves, regulators, fire extinguishers, instruments and similar products where the parts require intricate machining or are to be made at high speed in automatic machines. The alloy can be cold headed in the manufacture of bolts.
"K" Monel	●	●	●	..	●	..	●	..	..	Extra strong, rustproof, corrosion resisting alloy that can be heat-treated, and will develop strength and hardness comparable to heat-treated alloy steels. It is non-magnetic under ordinary conditions, and remains so at subnormal temperatures.	Corrosion-resisting applications where material must be machined or formed, then heat-treated to secure required hardness and strength. Used for large valve stems, pump rods, shafts, wearing sleeves, scrapers and aeronautical instrument parts.
"KR" Monel	..	●	..	..	..	..	●	..	..	Free machining grade of "K" Monel. It has substantially the same nominal composition, mechanical properties and resistance to corrosion as "K" Monel, and is heat-treatable to secure maximum hardness and strength.	Developed especially for screw machine parts where a heat-treatable material similar to "K" Monel must be used for intricate machined parts to withstand heavy loads.
"H" Monel	..	..	..	..	..	..	..	..	●	Special casting alloy with good strength and ductility. Used only for sand or centrifugally cast products. Castings are machinable with high-speed steel tools, but with slower speeds and lighter cuts than for steel. Tools must be strong.	Used for cast parts requiring corrosion and erosion resistance where stresses are high. Cast turbine nozzles and steam outlets often are made from this alloy.
"S" Monel	..	..	..	..	..	..	..	..	●	Special casting alloy having hardness nearly as great as white iron used in pulverising equipment, compares well with bearing bronze in its resistance to galling. Has more resistance to shock than soft gray iron. Retains hardness and resistance to galling at high heats.	Castings of this alloy are used for non-galling valve seats, disks and bushings used with high temperature steam. Also used for pump liners and sleeves that must withstand severe abrasion and corrosion. Soot blower parts and burner tips frequently are made of this alloy.
Inconel	●	●	●	●	●	●	●	..	●	Combines the corrosion resistance, strength and toughness of nickel, the basic metal, with the extra resistance to atmospheric and high-temperature oxidation imparted to metals by chromium, the principal alloying element. It may be fabricated readily, and is weldable.	Outstanding alloy for exhaust manifolds of airplane engines because of its ability to withstand repeated heating and cooling in the range from 0 to 1800 F. It is of special value in springs that operate at high temperatures because of its stiffness and high strength.
Hastelloy "A"	..	..	..	●	●	●	●	..	●	Nickel-molybdenum-iron alloy resistant to hydrochloric and sulphuric acids. Physical properties similar to high-strength alloy steel. Readily machined and welded. Makes good castings. Hardened by cold working — is softened by heating to high temperature and quenching.	Hastelloy alloys can be made into a wide variety of fabricated and machined parts, such as kettles, autoclaves and other reaction vessels; condensers, heat exchangers, evaporators and dryers; tanks mixers and agitators; heaters, injectors and exhausters; fans and blowers; coils and specially shaped pipe, tubing and strip; pyrometer equipment; wire screen and cloth; chlorinating equipment; spun parts, drawn parts and screw machine products. Alloys *A* and *B* can be supplied as castings, forgings, hot-rolled bars, strip, plate, sheets, rods, wire and welded tubing, and as cast or drawn welding rod. Alloy *C* is available as castings, plate, sheet, welded tubing, and cast welding rod. Alloy *D* is supplied only as castings and cast welding rod. The four alloys can be supplied as cast pipe in extra-heavy iron pipe sizes, as well as in special sizes. Such pipe is cast in short lengths, straight or curved, then welded to form required lengths. All four alloys are available as cast bars. Simple forgings can be made of alloys *A* and *B*, as can hot rolled bars.
Hastelloy "B"	..	..	..	●	●	●	●	..	●	Nickel-molybdenum-iron alloy having higher percentage of molybdenum than alloy *A*. Well suited for equipment handling boiling hydrochloric acid and wet hydrochloric acid gas. Physical properties like alloy *A* but is stronger, particularly at elevated temperatures.	
Hastelloy "C"	..	..	..	●		●	..	..	●	Nickel-molybdenum-chromium-iron alloy. Withstands strong oxidising agents like nitric acid and free chlorine. Machinable at moderate speeds and can be welded. It is not practicable to forge this alloy, hot or cold.	
Hastelloy "D"	..	..	..	..	..	..	..	..	●	Cast alloy composed mainly of nickel and silicon — contains small amounts of copper, manganese and aluminum. Exceptionally resistant to sulphuric acid, but is not resistant to oxidizing agents. Extremely hard, is not workable, machined with difficulty, finished by grinding.	
Illium "G"	..	..	..	..	..	..	..	..	●	Cast alloy composed mainly of nickel and chromium, with small amounts of molybdenum, copper, iron, manganese, silicon and carbon. Used principally in association with sulphuric, nitric and phosphoric acids through wide range of temperatures and concentrations. Resistant to highly oxidising acid conditions. Is machined without difficulty, welds readily.	The Illium alloys possess unusual corrosion resistance, high strength, machinability, and ability to resist erosion. Illium "G" is furnished only in cast forms, as castings, hardware, bar stock, centrifugally-cast pipe and welding rod. Illium "R" is supplied as castings, and as wrought sheet, strip, bar stock, welded tubing and hardware. Both alloys are employed in the construction of processing equipment for the chemical and petroleum refining industries, for making explosives, and for the magnesium, aluminum, copper, zinc, and steel industries.
Illium "R"	●	●	..	●	..	●	●	..	●	Wrought and cast alloy with almost the same composition as Illium "G". Has essentially the same resistance to corrosive agents. In either wrought or cast form, it can be machined without difficulty and is readily welded by oxyacetylene flame or metallic arc processes.	

CHARACTERISTICS OF WROUGHT AND

ALLOYS AVAILABLE (Trade Names)	APPROXIMATE CHEMICAL COMPOSITION Percent											AVERAGE MECHANICAL PROPERTIES											
	Nickel [1]	Copper	Iron	Manganese	Carbon	Silicon	Sulphur	Aluminum	Chromium	Molybdenum	Tungsten	Form and Condition	Tensile Strength 1,000 lb. per sq. in.	Yield Strength in Tension (0.2% offset) 1,000 lb. per sq. in.	Elongation in 2 in. Percent	Reduction of Area Percent	Short Time Ultimate Tensile Strength 1,000 lb. per sq. in.	Yield Strength in Compression (0.2% offset) 1,000 lb. per sq. in.	Shear Strength 1,000 lb. per sq. in.	Fatigue Endurance Limit 1,000 lb. per sq. in.	Hardness — Brinell 10 mm. ball (3,000 kg.)	Hardness — Rockwell	Impact Strength Izod (Ft. Lb.)
	Ni	Cu	Fe	Mn	C	Si	S	Al	Cr	Mo	W												
Nickel (Wrought) (Commercially Pure)	99.4	0.1	0.15	0.2	0.1	0.05	0.005	....	....	....	....	Annealed	70	20	40	....	....	26	52	23[10]	100	B55	120+
												Hot-rolled	75	25	40	68	46[7]	23	....	....	110	B60	120+
												Cold-drawn	95	70	25	....	....	58	....	31.5[10]	170	....	120+
												Cold-rolled[5]	105	95	5	....	....	....	75	....	210	B100	....
Low-Carbon Nickel (Wrought)	99.4	0.1	0.15	0.04	0.02	0.05	0.005	....	....	....	....	Annealed	65	20	45	....	....	....	....	....	....	B25–55	....
"D" Nickel (Wrought)	95.2	0.05	0.15	4.5	0.1	0.05	0.005	....	....	....	....	Annealed	75	35	40	....	....	....	....	....	140	....	....
												Hot-rolled	90	50	35	60	....	....	....	....	150	B70	....
												Cold-drawn	100	80	25	....	....	....	....	....	190	....	....
"Z" Nickel (Wrought)	98.0	....	....	....	....	....	....	....	....	....	....	Hot-rolled	105	50	35	....	113[8]	....	....	....	180	....	120+
												Hot-rolled[4]	170	130	15	....	166[8]	....	....	....	320	....	25
												Cold-drawn	120	90	25	....	....	....	....	....	220	....	120+
												Cold-drawn[4]	175	135	15	....	....	....	....	....	340	....	25
Monel (Wrought)	67.0	30.0	1.4	1.0	0.15	0.1	0.005	....	....	....	....	Annealed	75	35	40	....	....	28	49	30[10]	125	B60	105
												Hot-rolled	90	50	35	....	23[7]	38	....	39.5[10]	150	....	110
												Cold-drawn	100	80	25	....	....	81	....	....	190	....	95
												Cold-rolled[5]	110	100	5	....	....	....	65	40[10]	240	B100	....
"R" Monel (Wrought)	67.0	30.0	1.7	1.1	0.1	0.05	0.035	....	....	....	....	Hot-rolled	85	45	35	....	....	....	....	....	145	....	96
												Cold-drawn	90	75	25	....	....	....	....	....	180	....	99
												Cold-drawn[3]	75	30	40	....	....	....	....	....	115	....	....
"K" Monel (Wrought)	66.0	29.0	0.9	0.4	0.15	0.5	0.005	2.75	....	....	....	Hot-rolled	100	45	40	....	72[7]	40	65	....	160	C 5	120+
												Hot-rolled[4]	150	110	25	....	95[7]	121	....	....	280	C32	40
												Cold-drawn	115	85	25	....	....	76	....	....	210	C23	56
												Cold-drawn[4]	155	115	20	....	....	121	99	....	290	C34	26
"KR" Monel (Wrought)	66.0	29.0	0.9	0.4	0.3	0.5	0.005	2.75	....	....	....	Hot-rolled	105	65	40	....	....	....	....	....	185	....	....
												Hot-rolled[4]	150	105	25	....	....	....	....	....	280	....	....
												Cold-drawn	115	85	25	....	....	....	....	....	215	....	....
												Cold-drawn[4]	155	115	25	....	....	....	....	....	290	....	....
Inconel (Wrought)	79.5	0.2	6.5	0.25	0.08	0.25	0.015	....	13.0	....	....	Annealed	85	35	45	68	....	28	61	....	150	B70	120+
												Hot-rolled	100	60	35	66	83[7]	42	....	....	180	B88	110
												Cold-drawn	115	90	20	62	....	105	....	....	200	C28	85
												Cold-rolled[5]	135	110	2	....	....	....	82	....	260	....	....
Hastelloy "A" (Wrought)	Bal.	....	23.0[2]	*	*	*	....	....	....	23.0[2]	....	Hot-rolled[3]	110–120	47–52	40–48	40–54	23[9]	....	....	....	200–215	B94–97	62–77
Hastelloy "B" (Wrought)	Bal.	....	7.0[2]	*	*	*	....	....	....	33.0[2]	....	Hot-rolled[3]	130–140	60–65	40–45	40–45	25[9]	....	....	....	210–235	B96–100	68–78
Hastelloy "C" (Wrought)	Bal.	....	7.0[2]	*	*	*	....	....	18.0[2]	20.0[2]	6.0[2]	Hot-rolled[3]	115–128	55–65	25–50	....	22[9]	....	....	....	160–210	B84–95	34–40
Illium "R" (Wrought)	60.0	3.0	8.0	1.25	0.1	0.65	....	....	21.0	5.0	....	Hot-rolled[3]	100	50	32	....	....	....	....	....	190	B91	....
												Cold-rolled[5]	150	100	12	....	....	....	....	....	365	C39	....
Nickel (Cast)	96.7	0.3	0.5	0.5	0.5	1.5	0.01	....	....	....	....	Sand-cast[6]	50	25	25	....	....	....	....	....	100	....	80
Monel (Cast)	67.0	29.0	1.5	0.9	0.3	1.25	0.015	....	....	....	....	Sand-cast[6]	80	35	35	....	....	....	....	....	135	....	70
"H" Monel (Cast)	65.0	29.5	1.5	0.9	0.1	3.0	0.015	....	....	....	....	Sand-cast[6]	100	60	15	....	....	....	....	....	210	....	40
"S" Monel (Cast)	63.0	30.0	2.0	0.9	0.1	4.0	0.015	....	....	....	....	Sand-cast[3]	90	70	3	....	....	....	....	....	275	....	5
												Sand-cast[6]	130	100	3	....	....	....	....	....	320	....	3
												Sand-cast[4]	130	100	3	....	....	....	....	....	350	....	3
Inconel (Cast)	77.75	0.25	6.0	0.25	0.25	2.0	0.01	....	13.50	....	....	Sand-cast[6]	85	40	20	....	....	....	....	....	175	....	80
Hastelloy "A" (Cast)	Bal.	....	23.0[2]	*	*	*	....	....	....	23.0[2]	....	Sand-cast[3]	60–78	43–45	8–12	16–18	....	....	....	....	155–200	B85–94	25–35
Hastelloy "B" (Cast)	Bal.	....	7.0[2]	*	*	*	....	....	....	33.0[2]	....	Sand-cast[6]	75–82	55–57	6–9	10–13	....	....	....	....	190–230	B92–99	11–16
Hastelloy "C" (Cast)	Bal.	....	7.0[2]	*	*	*	....	....	18.0[2]	20.0[2]	6.0[2]	Sand-cast[6]	72–80	45–48	10–15	11–16	....	....	....	....	175–215	B89–97	9–14
Hastelloy "D" (Cast)	Bal.	4.0[2]	....	*	*	11.0[2]	....	*	....	....	....	Sand-cast[6]	36–41	36–41	0	0	....	....	....	....	....	C50–55	....
Illium "G" (Cast)	57.9	6.0	6.0	1.25	0.2	0.65	....	....	22.0	6.0	....	Sand-cast[6]	68	50	9.5	....	....	....	....	....	180	B89	....
Illium "R" (Cast)	60.0	3.0	8.0	1.25	0.1	0.65	....	....	22.0	5.0	....	Sand-cast[6]	70	50	9.5	....	....	....	....	....	180	B89	....

* Small amount, usually less than 1 percent.

[1] Includes a small amount of cobalt, which has but slight effect upon the properties of the alloys and is not detrimental.

[2] Maximum percentage.

[3] Annealed. [4] Age-hardened. [5] Hard temper. [6] As-cast.

[7] At 1000 F. [8] At 600 F. [9] At 1832 F.

[10] Rod tested in air to 100,000,000 cycles without failure.

CAST NICKEL-BASE ALLOYS

Relative Suitability for Hot Working [11]	Relative Suitability for Cold Working [11]	Relative Suitability for being Welded [11]			Relative Machinability [11]	AVERAGE PHYSICAL CONSTANTS										RESISTANCE TO VARIOUS CORROSIVE MEDIA
		Oxyacetylene	Metallic Arc	Resistance		Specific Gravity (Grams per cu. cm.)	Specific Gravity (Pounds per cu. in.)	Melting Range Degrees F.	Specific Heat (32 to 212 F.) B.t.u./lb./deg. F.	Mean Coeff. of Thermal Expansion (32 to 212 F.) (+ 10^{-6}) in./in./deg. F.	Thermal Conductivity (32 to 212 F.) B.t.u. (sq. ft./ hr./deg. F./in.	Electrical Resistivity (32 F.) Ohms per cir. mil. ft.	Tensile Modulus of Elasticity 1,000,000 lb. per sq. in.	Torsional Modulus of Elasticity 1,000,000 lb. per sq. in.	Poisson's Ratio (Factor of lateral contraction)	
A	A	A	A	A	C	8.89	0.321	2615–2635	0.130	7.2	420	57	30	11	0.31	Has outstanding resistance to corrosion by caustic soda. Does not readily discharge hydrogen from any of common acids — a supply of some oxidising agent, such as dissolved air, is necessary for corrosion to proceed. Oxidising conditions generally favor corrosion of nickel while reducing conditions retard it.
A	A	A	A	A	C	8.89	0.321	2615–2635	0.130	7.2	420	57	30	11	0.31	Has essentially the same immunity to rust and corrosion as wrought nickel.
A	A	A	A	A	C	8.78	0.317	2600	0.130	7.4	335	110	30	11	....	Superior to nickel under oxidising sulphurous conditions at elevated temperatures. Oxidizes more rapidly at first, but resists attack by sulphur. Not generally used under high-temperature reducing conditions, either in the presence or absence of sulphur. This alloy is highly resistant to conditions of electrical sparking.
B	B	B	B	A	D	8.75	0.316	2615–2635	0.130	7.2	420	100 [8] 94.5 [4]	30	11	0.31	General resistance to corrosion of "Z" Nickel is of the same order as that of nickel and its choice over the latter for any application should be based primarily on mechanical requirements. It work hardens more rapidly than does nickel and can be further hardened by heat-treatment at low temperatures.
A	A	A	A	A	B	8.84	0.319	2370–2460	0.130	7.8	180	290 [8]	26	9.5	0.32	More resistant than nickel under reducing conditions and more resistant than copper under oxidising conditions. Monel is resistant to most acids, alkalies, salts, waters, food products, organic substances and atmospheric conditions, both at normal and at elevated temperatures. It is not used with highly oxidising acids.
X	A	X	X	X	A	8.84	0.319	2370–2460	0.130	7.8	180	290 [8]	26	9.5	0.32	Has essentially the same immunity to rust and corrosion as Monel.
A	A	A	A	A	C [12]	8.47	0.306	2400–2460	0.130	7.8	130	350	26	9.5	0.32	Generally corrosion resistance is the same as for Monel in mineral and organic acids, alkalis, salts, potable and industrial waters, food products, organic compounds and atmospheric oxidation at normal and high temperatures.
X	B	X	X	X	B [12]	....	....	....	....	....	....	....	....	....	....	Has essentially the same immunity to rust and corrosion as "K" Monel.
A	A	A	A	A	C	8.51	0.307	2540–2600	0.110	6.4	104	.....	31	11	0.29	Chromium content makes Inconel superior to pure nickel under oxidising conditions while its high nickel content enables it to retain good resistance under reducing conditions. It is highly resistant to attack in many strongly oxidising acid solutions, and has excellent resistance to corrosion by alkaline solutions.
C	C	A	A	A	B	8.80	0.318	2372–2426	0.094	6.1	116	760	27	....	....	Withstands action of hydrochloric acid in all concentrations at temperatures up to 158 F. Resistant to sulphuric acid of any concentration up to 158 F. and to all concentrations below 50% up to boiling point. In addition, is resistant to acetic, formic and other organic acids, but not to oxidising agents.
C	C	A	A	A	C	9.24	0.334	2408–2462	0.091	5.6	78.5	813	30.8	....	....	Particularly well suited for equipment handling boiling hydrochloric acid and wet hydrochloric acid gas. Resistance to sulphuric acid better than that of alloy *A*. Has good resistance to phosphoric acid and is practically unaffected by alkalies. Not recommended for use with nitric acid or other acid oxidizers.
C	C	A	A	A	C	8.94	0.323	2318–2381	0.092	6.3	87	800	28.5	....	....	Is unique in its resistance to hypochlorite solutions and to moist chlorine at temperatures up to 105 F. Resistant to hydrochloric acid up to 122 F., to dilute nitric acid up to 150 F., and to oxidising solutions.
C	C	B	A	B	B	8.31	0.310	2375	0.110	5.1	.....	740	27.5	9	....	Resistant to all concentrations of nitric and phosphoric acids at all temperatures, also resistant to oxidising acid mixtures. Usefully resistant to sulphuric acid under all conditions of concentration, aeration, agitation and temperature. Resistant to hydrochloric acid to about 15 percent concentration at room temperature, not above.
X	X	B	B	X	C	8.40	0.303	2540–2600	0.130	7.4	410	125	30	11	....	Has essentially the same immunity to rust and corrosion as wrought nickel.
X	X	B	B	X	B	8.63	0.312	2400–2450	0.130	6.8	180	320	26	9.5	....	Has essentially the same immunity to rust and corrosion as wrought Monel.
X	X	X	X	X	C	8.50	0.307	2350–2400	0.130	6.8	180	370	26	9.5	....	Has good strength and ductility, and its resistance to corrosion is comparable to that of wrought nickel. This alloy is used for cast turbine nozzles and steam outlets, and in rotating parts where the stresses are high.
X	X	X	X	X	C	8.40	0.303	2300–2350	0.130	6.8	180	380	26	9.5	....	This 4% silicon alloy has high hardness plus resistance to galling, but its ductility is low. Resistance to galling and retention of strength at elevated temperatures cause this alloy to be selected for valve seats and disks, pump parts, burner tips and blower parts. Resists shock better than soft gray iron. Corrosion resistance comparable to that of wrought Monel.
X	X	B	B	X	C	8.30	0.300	2500–2550	0.110	.....	.....	.....	31	11	....	Has essentially the same immunity to rust and corrosion as wrought Inconel.
D	D	A	A	A	B	8.80	0.318	2372–2426	0.094	6.1	116	760	27	....	....	Has essentially the same immunity to corrosion as wrought Hastelloy alloy "A".
D	D	A	A	A	C	9.24	0.334	2408–2462	0.091	5.6	78	813	30.8	....	....	Has essentially the same immunity to corrosion as wrought Hastelloy alloy "B".
D	D	A	A	A	C	8.94	0.323	2318–2381	0.092	6.3	87	800	28.5	....	....	Has essentially the same immunity to corrosion as wrought Hastelloy alloy "C".
D	D	A	D	X	D	7.80	0.282	2030–2048	0.109	6.1	145	680	28.9	....	....	Exceptionally resistant to sulphuric acid of all concentrations up to boiling point. Resistant to hydrochloric acid fair at moderate temperatures. Practically unaffected by acetic or formic acid, and has low corrosion rate in phosphoric acid. It is not resistant to strong oxidising agents such as nitric acid.
X	X	B	A	B	C	8.31	0.310	2375	0.105	7.5	.....	735	....	....	....	Resistant to all concentrations of nitric and phosphoric acid at all temperatures, also resistant to oxidising acid mixtures. Usefully resistant to sulphuric acid under all conditions of concentration, aeration, agitation and temperature. Resistant to hydrochloric acid to about 15% concentration at room temperature, not above.
X	X	B	A	B	C	8.31	0.310	2375	0.110	5.1	.....	740	....	....	....	Has essentially the same immunity to corrosion as cast Illium "G".

[11] Relative hot and cold workability, weldability and machinability are indicated as follows: A = Excellent, B = Good, C = Fair, D = Poor and X = Not recommended. Ratings are based on the high-nickel alloys shown, as a group, and are not to be used in comparison with other metals, even though they may have a high nickel content.

[12] Not age-hardened.

metallic elements. It is exceptionally resistant to sulphuric acid of all concentrations, even up to the boiling point. It is not resistant to strong oxidizing agents. Alloy *D* is similar in physical properties to a high-grade gray cast iron. Due to its high silicon content, however, the as-cast alloy has an average hardness of Rockwell C 50-55 and low impact strength. Its hardness is reduced and its toughness and impact strength are appreciably increased by a toughening anneal. Because of its hardness, alloy *D* possesses good abrasion resistance, and it is non-galling when used with alloys *A*, *B* or *C*, or austenitic steels. But, for the same reason, the alloy is not workable, and can be machined only with great difficulty; it must be finished by grinding.

Illium Alloys—The Illium alloys are the result of a search for a material resistant to both sulphuric and nitric acids over a wide range of concentration and exposure conditions. Illium is made in two compositions, each of which retains the basic resistance to corrosion characteristic of the alloy. Illium *G* alloy is used in sand and centrifugal castings and Illium *R* alloy is available both in case and wrought (strip, sheet, welded tubing and rolled rod) forms. They are superior under highly oxidizing conditions, such as in contact with nitric acid, and have limited applications in hydrochloric acid and acid chlorides. Machining of Illium is relatively slow and light feeds are required. Considerable reduction in machining time can be obtained by using cemented carbide tools.

HOT AND COLD WORKING NICKEL-BASE ALLOYS

HOT FORMING

The high-nickel alloys show important differences among themselves as to proper forging temperatures, particularly in the upper safe heating limits and in tendencies toward red-shortness. While heating these materials, the furnace should be maintained at a temperature about 50 F. higher than that at which the work is to be forged. Maintaining forging furnaces at excessively high temperatures to reduce heating time and speed up production is damaging to these alloys.

Furnace atmosphere must be sulphur-free and should be kept in a slightly reducing condition, with two percent or more of carbon monoxide. Do not let it alternate from reducing to oxidizing. Leave ample space to burn the fuel completely before the hot gases strike the work—otherwise the work may be damaged through embrittlement. Do not leave high-nickel billets exposed to combustion gases in a heating furnace longer than the minimum time required to heat the piece uniformly through. When a number of pieces are to be forged, they should be charged at intervals as nearly equal to the time required for forging each piece as is practical. The metal should be supported on steel rails and not be allowed to touch the furnace floor.

The high-nickel alloys are considerably stronger and stiffer than steel at forging temperatures. It may be necessary, for some forgings, to use heavier hammers and larger machines than would be used normally for steel. This applies particularly to single-blow operations, as in heading rivets and bolts, and in pressing. Drop forgings are produced readily from these materials, but the stock should be overhauled to remove the hot-rolling oxide and any slight surface imperfections.

Forge- or hammer-welding is not possible with these alloys. Also, they are not "free-scaling" during forging. Drop forging dies and operations should be laid out so that forging laps will not occur. Dies must be designed so that the metal will not be forged to sharp corner sections until complete spreading has been accomplished. It is advisable to preheat the dies before forging any of the alloys.

Either carbon or alloy steels may be used to make die blocks for drop forgings or pressings. Dies of 0.80 percent carbon steel, hardened and tempered to 60 Scleroscope, can be expected to stand up well on smaller forgings in nickel and Monel. Alloy steel dies are almost a necessity for the larger or more intricate shapes in Monel or nickel, and for all forgings in Inconel except small, simple shapes. Widely used as a die block material is a nickel-chromium-molybdenum steel containing about 0.55 percent carbon, 1.5 percent nickel, 0.75 percent chromium and 0.35 percent molybdenum, heat-treated to about 43 Rockwell C.

High-nickel materials have a slightly greater tendency to stick in forging dies than does steel, especially with difficult shapes. Swabbing with a mixture of heavy grease and graphite aids in clearing the work from the die. Sawdust thrown into the die is also useful in preventing sticking.

High-speed steel should be used for trimming dies. Cutting edges of these dies should be ground with considerable rake, and the dies should be set up closely enough to cut tissue paper. Trimming may be done either hot or cold.

The following recommendations for hot working the individual alloys should be followed:

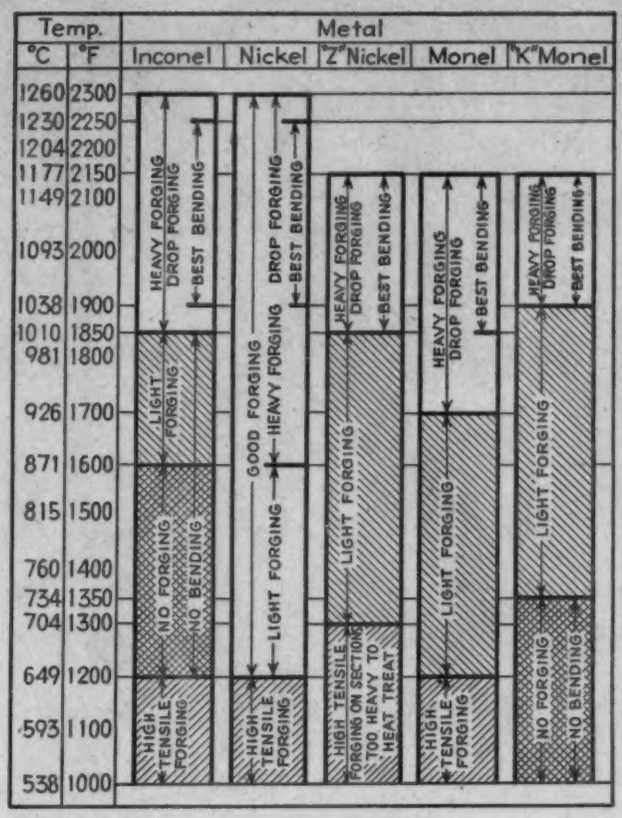
Nickel—Recommended range of hot-working temperatures is 2300 to 1200 F., but since the metal stiffens rapidly at about 1600 F., all heavy forging should be done above that temperature. High physical properties can be produced by forging lightly between 1000 and 1200 F. The best range for hot bending is 2250 to 1900 F. Do not heat the metal above 2300 F.

"Z" Nickel—It is necessary to carry out all heavy work at temperatures above about 1800 F., but light finishing work may be carried out down to about 1600 F. The material stiffens rapidly below 1800 F. Any hot working below 1600 F., or heavy work below 1800 F., may result in damage to the material. If heat-treatment is to follow, it is necessary to reheat to 1950 to 2000 F. and then quench.

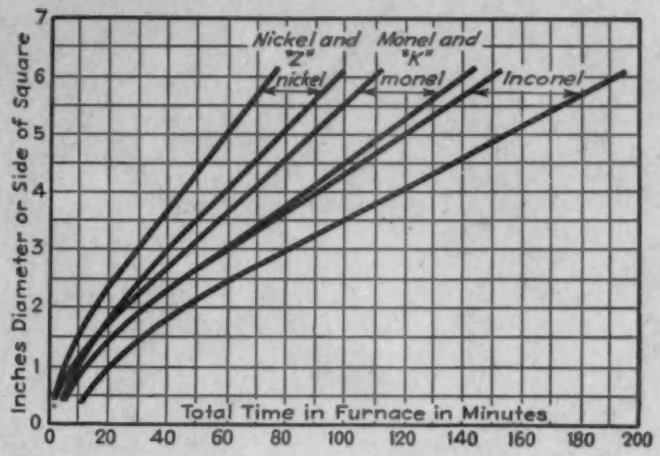
Monel—Recommended range of forging temperatures is 2150 to 1600 F. All heavy forging should be done above 1850 F. Hot-bending range is 2150 to 1850 F. Do not heat the metal above 2150 F.

"K" Monel—This alloy should always be charged in a hot furnace, never placed in a cold furnace and brought up to temperature with the furnace. Best temperature range for heavy forging and bending is 2150 to 1900 F.; however, it can be commercially forged down to 1700 F. If it becomes necessary to reheat "K" Monel in order to complete the work, the metal should be recharged in the furnace with a minimum of delay. *When hot working has been completed, or when it is found necessary to allow "K" Monel to cool before further hot work, the metal should not be allowed to air cool but should be quenched from a forging temperature of* 1450 *F., or above.* The preferred quenching medium is water with about two percent by volume of alcohol. Unless quenched, the piece will self-heat-treat to some extent on cooling and set up stresses that may result in cracks or in surface tears either during cooling or during subsequent heating. Do not attempt to increase the strength of "K" Monel forgings by semi-cold forging.

Inconel—The major part of forging should be done between 2300 and 1850 F. Light working without ten-



Approximate temperature ranges for hot forging and bending nickel and various nickel alloys



Approximate time required for heating bars of different dimensions

sile or bending stresses can be continued as low as 1600 F., but no work should be attempted between this point and 1200 F. because of lower ductility within that range. Work done below 1200 F. should be classed as cold work.

Hastelloy Alloys—Hot forming of sheet and plate can be carried out above 1900 F. and up to 2150 F. for alloys *A* and *B*, and up to 2200 F. for alloy *C*, as long as the flow of the metal is not too rapid. These alloys possess a brittle range between 1200 and 1900 F., and cracking may occur in this temperature range unless the flow of the metal is extremely slow. Severe forming operations, such as dishing and flanging, rolling heavy plates into small cylindrical shapes, and plain flanging, must be performed hot. When forming between dies, care must be taken that the metal is not cooled too rapidly into the brittle range by contact with cold dies before the forming is completed. It is often necessary to reheat several times during particularly severe forming operations. When this is necessary, the material should be given a short soak at the full annealing temperature to offset any work-hardening which may have occurred during the previous step. After hot forming it is advisable to give a full anneal or stabilizing anneal to impart corrosion resistance to the sheet.

Simple forgings can be made from Hastelloy alloys *A* and *B*. Forging operations must be carried out at 1900 F. or above to avoid cracking. The optimum forging temperature is about 2100 F. for both alloys.

COLD FORMING

Nickel, Monel and Inconel behave similarly in many respects to mild steel in mechanical cold working operations, such as cupping, drawing, swaging, die-forming, power-hammering, bending and forming. The elastic limit is higher, so more power is required. Inconel requires more power in drawing than do nickel and Monel. High strengths limit manual operations, such as spinning, bumping, and hand-hammering to easy shapes. Cupping dies are made of gray iron, chilled iron, alloy castings, chromium-plated hardened steel or hard bronze. Tungsten carbide dies sometimes are used. All die surfaces should be highly polished. Tallow, soap, sulphur-base oil, castor oil and similar heavy lubricants are used in connection with cold working operations.

Low-carbon nickel is softer than the regular alloy and does not work-harden as rapidly. For this reason, it is sometimes preferred for making spun, drawn or stamped parts. The ductility of "Z" Nickel permits considerable cold working without danger of fracture. However, it work hardens more rapidly than nickel and more frequent annealing is required.

The cold working properties of "K" Monel are similar to those of Monel. However, because of its greater hardness in all forms, and its greater rate of hardening with cold work; more power is required than for Monel in corresponding operations. In the anneal condition, "K" Monel can be drawn, formed, upset, bent, swaged or otherwise cold worked. Its high ductility permits severe deformations without damage.

Hastelloy alloy *A*, *B* and *C* sheet and plate can be formed cold by simple operations such as shallow dishing without flanging, or rolling thin sheets into cylindrical shapes. Cold-forming work hardens the alloys, but generally not sufficiently to necessitate subsequent heat-treatment for maximum corrosion resistance. Greater power is required than for mild steel.

For the more severe forming operations on these materials, best practice calls for the use of heat.

Drawing and forming of Illium *R* strip may be done if hardness is below 240 Brinell. Since Illium *R* work-hardens rapidly, intermediate annealing is sometimes necessary if the draw is deep.

SHEARING

Power required to shear Monel, nickel and Inconel sheet and strip has been shown by tests to run from 113 to 119 percent, in the soft tempers, to about 130 percent, in the full-hard tempers, of that needed to shear mild steel of equal gage. Shear blades must be set up tightly and kept sharp. Hastelloy alloy *A*, *B* and *C* sheet and plate can be sheared hot or cold, but these alloys are much stiffer and stronger, particularly at elevated temperatures, than ordinary sheet and plate materials and require more power to shear. A shear which will handle a given maxi-

mum thickness of mild steel plate will handle only about 50 percent of that thickness in Hastelloy alloy plate.

PUNCHING

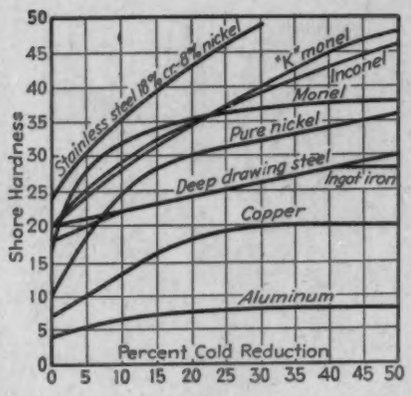
Soft to skin-hard temper is preferable in material to be perforated. Die and punch clearance should be the same as for neat steel punching; for ¼ in. and heavier plate it is often desirable to use slightly less clearance than for steel in order to produce a clean hole, free from burrs. A close clearance should be maintained between the punch and the stripper plate. An accompanying table gives practical rules for the selection of the minimum size hole that can be punched in a given thickness of soft to quarter-hard temper sheet. Punches and dies should be made of alloy steel, heat-treated to a tough temper of about 58 to 61 Rockwell C. A heavy sulphur-base oil should be used in punching—it must be thoroughly removed before the perforated sheet is heated for annealing or any other purpose. From 15 to 20 percent more shear load is required to perforate these high-nickel alloys than is needed for mild steel of equal gage.

DEEP DRAWING

Monel, nickel and Inconel deep drawing quality sheets and strip may be drawn into any shape feasible with deep drawing steel. Few commercial operations require changes or variations in die equipment designed for drawing steel or brass. In a few cases calling for severe drawing and extreme accuracy, modifications must be made.

Gray and cast semi-steel dies are satisfactory for short runs of a few hundred pieces. Hard bronzes, heat-treated nickel-chromium cast iron, chromium-plated hardened steel, and, for very small work, tungsten carbide, are recommended for dies used on large production runs. High-nickel materials have a tendency to gall against carbon steel dies, and they should not be used. Dies and punches must be kept well polished. Beef tallow and castor oil are good lubricants; so also are water-soluble or oil-soluble lubricants compounded from these two substances and containing fillers. White-lead and graphite, also sulphur-bearing lubricants, are excellent but must not be used if the parts are to be annealed after drawing. All lubricants should be removed completely before annealing. When drawn shells reach a Rockwell hardness of B 95, or over, annealing usually is necessary.

Monel and nickel require only slightly more die clearance than steel. The difference is so small that little



Increase in hardness of various metals and alloys with cold working —starting with annealed material

difficulty ordinarily is experienced when drawing over dies originally laid out for steel. For ordinary deep drawing of light-gage cylindrical shells, an over-all clearance equal to about 40 to 50 percent of the thickness of the material is ample. With heavy-gage sheets, the over-all clearance generally is about equal to the thickness of the stock. The curved surface over which the material is drawn should have radii as great as possible without developing wrinkles in the shell. Draw-ring and punch-nose radii for light-gage cylindrical shells are usually from 5 to 12 times the thickness of the stock. Corner-edge radius for a rectangular shell should be from 4 to 10 times stock thickness.

On a double-action press with pressure ring, a well-balanced series of reductions for light-gage cylindrical shells, with no "ironing" of the side walls, would be approximately 30 to 40 percent in the first or cupping operations, and 15 to 25 percent on redrawing operations. Single-action redraws, without pressure rings, rarely exceed 20 percent for light gages; however, with very slight diameter reductions (less than 5 percent), up to 30 percent reduction in wall thickness can be obtained. Experience has shown that the depth of rectangular draws should be limited to from two to four times the corner radius. The term "reduction" as used above refers to reduction of shell or blank diameter, and not to area reduction.

Thickness of Sheet	*Approximate Minimum Diameter of Hole*
.018 in. to .034 in. incl.	Thickness x 1.5
.037 in. to .070 in. incl.	Thickness x 1.3
.078 in. to .140 in. incl.	Thickness x 1.2
1/8 in. and heavier.....	Thickness x 1.0

Relation between thickness of sheet and minimum permissible hole diameter for punching Monel, Nickel and Inconel.

SPINNING

More power is required when spinning the high-nickel alloys, and more frequent annealing is necessary. The procedure for spinning high-nickel alloys is essentially the same as that used for other metals. The work should be laid down firmly with long, powerful strokes. The metal should not be crowded, and reworking over the same surface should be avoided as much as possible. Spinning should be stopped as soon as the metal ceases to flow. The article should then be trimmed and annealed preparatory to the next operation. A hard-surfaced chuck should be provided for each operation so the metal can always be pressed firmly against its surface. This keeps the surface of the metal smooth and dense.

The lubricant used is an important factor in successful spinning of these alloys. It should be heavy-bodied to withstand the high pressures and temperatures encountered. Yellow laundry soap is used most frequently; beeswax, tallow, or a mixture of the two, are satisfactory. The lubricant should be removed completely from the pieces before annealing. Lubricants containing sulphur or lead should never be used if the pieces are to be annealed, because of the embrittlement produced by these two elements.

The pressure required for spinning these alloys cannot be exerted with the ordinary bar or hand tool pivoted on a fixed pin, except for very light, small shapes. Most spinning requires a tool that is mechanically adapted for the application of greater force, such as a compound-lever tool or roller tools which are operated by a screw. Wherever possible the tool should be broader and flatter than normally used for other materials. The broader tool distributes plastic flow over a greater area and reduces over-straining.

The most suitable material for bar tools is a highly polished, hard-alloyed bronze. Hardened tool steels are preferred for roller and beading tools. Common brass and carbon steels are unsatisfactory as tool materials. Rotary cutting shears are preferred for edge trimming. If these are not available, Stellitt-tipped hand trimming bars may be employed but the trimming speed must be reduced. Hand trimming bars must be ground so that there is a back slope of about 15 to 20 deg. from the cutting edge, and the cutting edge must be kept sharp.

HEAT-TREATING PROCEDURES

Nickel and the high-nickel alloys are subject to annealing heat-treatments to accomplish softening after cold working, to relieve stresses induced by cold working or by welding, to increase machinability, to restore corrosion resistance, and for other reasons. Also, six of these alloys—"Z" Nickel, "K" Monel, "KR" Monel, "S" Monel, and Hastelloy alloys *B* and *C*—can be age-hardened by the precipitation process.

Three annealing treatments may be applied to nickel, low-carbon nickel, "Z" Nickel, Monel, "K" Monel, "R" Monel, Inconel, and nickel-, Monel- and Inconel-clad steels. These are: (1) soft annealing so that cold working can be continued, (2) temper or partial annealing, limited to light sections and usually applied only to strip and wire where fully annealed material is not required, and (3) stress-equalizing annealing of cold-worked and hot-worked alloys that require a low-temperature thermal treatment to develop the optimum combination of strength and ductility, and to insure against distortion and warping upon subsequent machining.

The temperatures required for soft annealing and for temper annealing the alloys listed above are sufficiently high to cause slight surface oxidation. If a bright, unoxidized surface is desired, care must be taken to provide a sulphur-free, reducing atmosphere. If oxidation is not important, the furnace atmosphere need be sulphur-free only, although a strongly oxidizing atmosphere is not recommended. In either case, adequate control of the magnitude and the uniformity of temperature are essential.

Soft annealing can be carried out by either the box or open methods. Box annealing may be used for small parts, rivets, wire and strip in coils, and similar items. Open annealing in oven-type reverberatory furnaces is used for larger cupped and drawn shapes, spinnings, rods, tubes, castings and other forms; it is the method most frequently used for bright annealing. Box annealing is not suitable for softening "K" Monel as this alloy must be cooled rapidly to prevent age-hardening. Salt bath annealing is used for special work with small parts.

Some classes of work, particularly pieces for spinning, call for softer annealing than others. The more severe the nature of the subsequent cold-working operation the longer must be the time at temperature. However, the greater the amount of cold work to which the material has been subjected prior to annealing, the lower is the annealing temperature required to produce the same degree of softness without increasing grain size, or the shorter is the time required at any one temperature. In annealing the high-nickel alloys, the time-temperature relationship is of prime importance with respect to grain growth.

The amount of previous cold work also has a critical influence upon the ductility of nickel and nickel alloys after annealing; this is true regardless of the type of cold work. If only a small amount is done, for example, 10 percent reduction, full ductility cannot be restored by annealing, even though the hardness is reduced to that of soft material. A minimum of 20 percent of cold working between anneals is required to insure maximum ductility and softness following annealing. Internal fractures may result if a metal or alloy is cold worked excessively.

Neither slow cooling, whether in or out of the furnace, nor rapid cooling by quenching, have any specific effect on the softness of annealed nickel, Monel and Inconel. Rapid cooling is preferable both to economize time and to minimize the amount of oxidation. However, in the case of "Z" Nickel and "K" Monel, which age-harden during slow cooling, rapid cooling by quenching is essential if they are to be kept in a soft state.

The following general recommendations for annealing the individual alloys should be supplemented by shop trials and by consultation with the supplier in order to insure using the most efficient procedure:

Nickel—Box-annealing is done most satisfactorily at 1350 to 1450 F., for two to six hours at temperature; the total time in the furnace will depend on the rate of heating. The range for open annealing is 1600 to 1750 for two to five minutes at temperature, when mechanical work is to follow. If manual operations, such as spinning, are to follow, the annealing time should be about 50 percent longer in order to soften the material fully. Open annealed material should be quenched in a solution of 2 to 3 percent denatured alcohol in water to reduce the oxide flash.

"D" Nickel—The temperature for annealing the wrought nickel-manganese alloy "D" Nickel, with approximately 4.5 percent manganese, is 1300 to 1400 F.

Monel—Open-annealing range is 1650 to 1800 F. for two to five minutes at temperature, when mechanical work is to follow. Spinning and other manual operations may require up to seven minutes at temperature. Box-annealing is done at 1350 to 1450 F. for two to six hours at temperature. An alcohol quenching bath, in the proportion of 1 gal. of methyl or denatured alcohol to 50 gal. of water, will reduce the oxide flash that results when the work is brought out into the air, and give the part a silvery white surface. A pink color after the alcohol quenching indicates oxidation in the furnace and improper heating conditions, or an undue delay in quenching. "R" Monel requires approximately the same treatment as Monel for annealing.

Inconel—When cold worked heavily, only slight effects on the physical properties are observed upon subsequent heating up to 1000 F. At about this temperature internal stresses begin to be relieved. They are almost completely relieved by heating for 1½ hr. at 1400 F., with only slight softening. Softening by annealing begins at about 1600 F., and is reasonably complete in 10 to 15 min. heating at 1800 F. Above this temperature, grain growth may be objectionable, although very brief heating at 1900 F. will cause complete softening without undue grain growth. The rate of cooling is unimportant; either quenching or furnace cooling will produce proper softening. Welded joints in Inconel do not require annealing or other heat treatment to insure best corrosion resistance. When annealing Inconel, the furnace atmosphere should be free from active oxygen and low in sulphur.

Illium-R—Annealing is accomplished by bringing Illium *R* to a temperature of 1900 F., and allowing it to soak at this temperature for three to five minutes, depending on the piece. Care must be taken in handling, as in the temperature range just above the annealing temperature Illium is "hot short." Unless annealed in an inert or reducing atmosphere, oxide forms which must be removed by pickling.

"Z" Nickel—This alloy must be quenched from a temperature of 1950 to 2000 F. in order to put it in condition to respond to precipitation hardening. The quench will fully anneal the material, and should be carried out prior to any cold working operations which are performed for the purpose of work-hardening. The effect of the quench is lost when the material is heated higher than about 900 F. in fabrication. When fabrication involves annealing between stages of cold working, the same procedure as for nickel

may be used on all anneals except the last, which must be a quench anneal from 1950-2000 F. if heat-treatment is to follow. When heating for quenching prior to heat-treatment, it is important that the furnace be held as closely as possible to 2000 F., and that the material be withdrawn on a rising temperature as soon as it is above 1950 F. throughout.

The required time and temperature for hardening "Z" Nickel will vary somewhat with the initial temper of the material. Those recommended for various temper groups are as follows:

(a) Soft "Z" Nickel—hot-rolled, forged or soft annealed material—(140 to 180 Brinell and 75 to 90 Rockwell B) is hardened by holding it for 16 hr. at 910 to 930 F., followed by furnace cooling or quenching.

(b) Moderately cold-worked "Z" Nickel—cold-drawn rods, half hard strip or cold-upset articles—(200 to 300 Brinell and 15 to 31 Rockwell C) is hardened by holding it at 900 to 920 F. for not less than 8 hr., followed by furnace cooling or quenching. Additional hardness can be obtained by holding as long as 16 hr. at temperature, in cases where the original hardness is near the lower limits of the range given above.

(c) Fully cold-worked "Z" Nickel—full-hard strip, spring-temper wire, and heavily cold-worked parts—(290 to 375 Brinell and 30 to 40 Rockwell C) is hardened by holding it at 890 to 910 F. for 6 hr. Increasing the time to 8 hr. will be beneficial where the original hardness is near 30 Rockwell C.

"K" Monel—This alloy is hardened by a single thermal treatment consisting of aging at the required temperature, followed by controlled cooling. No preliminary quenching treatment is required. During fabrication, after cold work, or on heat-treated material that is to be softened for machining or further cold working, the alloy may be annealed by the following procedure:

Heat to 1600 F. for 2 to 5 min. at temperature, or to 1800 F. for ½ to 2 min. at temperature, and cool rapidly in a water quench containing 2 percent by volume of alcohol. If the material is held at temperature for a sufficient period of time it may be partially or completely softened by quenching from 1100 F. or higher. Rapid air cooling effects a mild quench and results in partial softening.

The correct temperature and time to be used in hardening will vary according to the initial temper of the material. Although a very slow cooling rate is specified in the following instructions, this need be followed strictly only if the maximum attainable hardness is desired. Practically complete hardening will result if a moderately slow cooling rate, such as 25 to 50 F. per hr., is used.

(a) Soft "K" Monel (140 to 180 Brinell, 75 to 90 Rockwell B) is hardened by holding it for 16 hr. at 1080 to 1100 F., followed by furnace-cooling to 900 F. at a rate not exceeding 15 F. per hr. Cooling from 900 F. to room temperature may be carried out by furnace cooling or air cooling, or by quenching, without regard to the cooling rate. Soft material can be hardened also by holding at 1200 to 1250 for 1 hr., followed by furnace cooling, at not exceeding 15 F. per hr., down to 900 F., with further cooling as above.

(b) Moderately cold-worked "K" Monel (175 to 250 Brinell, 8 to 23 Rockwell C) is hardened by holding it for 8 hr. or longer, at 1080 to 1100 F., followed by furnace cooling to 900 F. at a rate not exceeding 15 F. per hr. Higher hardness may be obtained by holding it for as long as 16 hr. at temperature, particularly if the material has been only slightly cold worked.

(c) Fully cold-worked "K" Monel (260 to 315 Brinell, 25 to 32 Rockwell C) is hardened by holding it at 980 to 1000 F. for 6 hr., or longer, followed by furnace cooling to 900 F. at a rate not exceeding 15 F. per hr. In some instances slightly higher hardness may be obtained (particularly with material near the lower end of the hardness range) by holding 8 to 10 hr. at temperature.

"S" Monel—For extensive machining, this 4 percent silicon casting alloy may be softened by heating at 1600 F. for 1 hr., air cooling to 1200 F., and then quenching in oil. This lowers the hardness to about 200 Brinell. After machining, the parts can be hardened by aging at 1100 F. for four to six hours, followed by furnace cooling. The aging treatment produces hardness as high as or higher than that of the alloy in the as-cast condition, and mechanical properties of the same order as those of the as-cast material.

HASTELLOY ALLOYS

Mechanical properties, structure and hardness of the four Hastelloy alloys may be controlled for various requirements by heat-treatment. The four types of standard thermal treatments for these alloys, their effects, and the purposes for which they are used, are as follows:

Full Anneal—This thermal treatment produces softness, toughness, machinability and high corrosion resistance, and is the one generally used on welded sheet to prevent deterioration in the area directly adjacent to the weld. In this treatment, alloys A and B are heated to 2100-2150 F. for from 20 min. (⅛-in. sheet) to 90 min. (2-in. plate or bar), and then cooled rapidly in air (or water for heavy sections). Alloy *C* is heated to 2200-2225 F. for two to three hours, according to mass, and then cooled rapidly in air.

Stabilizing Anneal—Used to reduce the loss of corrosion resistance and toughness due to exposure of the metal to elevated temperatures between 1200 and 1900 F., this thermal treatment also helps to reduce sheet deterioration adjacent to welds when applied to the sheet before welding, where heat-treatment after welding is not practical. On alloy *A* and *B* wrought material it results in corrosion resistance as good as, or slightly better than, the full anneal.

This treatment is most effective when preceded by the full annealing treatment. For the stabilizing anneal, alloys *A* and *B* are heated to 1925-1950 F. for two to four hours, and then cooled in air. Alloy *C* is heated to 2050-2075 F. for the same length of time and then air cooled.

Hardening Anneal—Employed only with alloys *B* and *C*, this thermal treatment produces the hardest possible condition (except by rolling not followed by annealing) in these alloys. It results in considerable reduction in corrosive resistance, but is used for increasing wear resistance and resistance to galling and seizing. It is an age-hardening process which must be preceded by the full anneal, and which requires a long time to produce the maximum hardness. By this heat-treatment a maximum hardness of Rockwell C 40 to 50 in alloy *B* and Rockwell C 35 to 40 in alloy *C* can be obtained. In this treatment, alloy *B*, in either cast or wrought form is held at 1375-1400 F. for one week and then cooled in air. Castings of alloy *C*, on the other hand, require only 16 hr. at a temperature of 1575-1600 F., with air cooling, for this hardening anneal. Alloy *C* wrought sheet or plate requires only 8 hr. at 1575-1600 F., and air cooling for this treatment.

Toughening Anneal—This is the only thermal treatment given Hastelloy alloy *D*. It results in considerable reduction in the brittleness of this cast material, and also lowers the hardness to Rockwell C 40 to 45 without affecting its corrosion resistance. The treatment consists of heating the castings slowly to 1925-1950 F., keeping them at this temperature for from two to four hours, according to mass, and then allowing them to cool slowly in the furnace.

PICKLING SOLUTIONS AND PROCEDURES

Soluble oils from nickel and its alloys can be removed with soap and hot water; tallow, fats and fatty acids with a hot 10 to 20 percent solution of soda ash or caustic soda; mineral oils and greases are freely soluble in carbon tetrachloride, kerosene and other solvents, but a film remains that must be removed by a final dip in a 10 to 20 percent solution of either caustic soda, trisodium phosphate, or a mixture of both.

The oxides produced on nickel, Monel and Inconel vary with heating conditions, and the proper pickling solution for removing these oxides must be selected accordingly.

Flash Pickling—Bright dipping, or flash pickling, is used to remove tarnish and dullness from cold-worked products finished with a white surface by annealing in a strongly reducing sulphur-free atmosphere, and either cooling out of contact with oxygen, or quenching in a 2 percent (by volume) alcohol solution. The action of flash pickling solutions is rapid and care must be exercised to prevent over-pickling and etching. Best results are obtained by first warming the parts by a dip in hot water, then passing them into the acid for a few seconds, followed by a hot-water rinse, and then into a second dip in the acid, if necessary. The final acid dip should be followed by rapid rinsing in hot or cold water, neutralization in 1 to 2 percent (by volume) ammonia solution (4 to 8 fl. oz. commercial aqua ammonia in 1 gal. of water), and drying by dipping in boiling water, followed by rubbing in dry sawdust, or with a dry cloth.

Best results with Monel and "K" Monel are obtained by using two pickling solutions, given in the accompanying table as Formulas No. 1 and No. 2, in sequence. The parts should be cleaned thoroughly while in the first dip, using only a short time for each exposure, then rinsed in hot water (180 F.), followed by a rapid dip in the second solution. Rinse and dry, as above.

Only one dip is required for nickel and "Z" Nickel using Formula No. 3. The parts are warmed first by dipping in hot water, then they are immersed in the acid bath for 5 to 20 sec., which usually is sufficient to brighten the nickel. Rinse and dry, as above.

Flash pickling of Inconel can be accomplished only after a descaling pickle, described in the following.

Removal of Reduced Oxide—At annealing temperatures in reducing atmospheres, the oxides formed on high-nickel alloys, excepting the chromium bearing alloys, are converted readily to a spongy, more or less adherent layer which on nickel consists of metallic nickel, and on Monel a mixture of metallic nickel and copper.

The solution given in Formula No. 4 is recommended for removing the reduced oxide film from hot worked nickel, "Z" Nickel, Monel and "K" Monel parts, which, prior to pickling, have been heated in a strongly reducing sulphur-free atmosphere, and cooled out of contact with air or by quenching in 2 percent (by volume) alcohol solution. After pickling, the parts should be rinsed in hot water and neutralized in the ammonia solution. This pickling operation is often facilitated by occasional immediate scrubbing with pumice on a fiber brush. It is advisable to maintain separate solutions for Monel and nickel. The solutions work better after having been in use for a while —in making up new solutions, about 2 percent (by volume) of spent solution should be added to the fresh solution.

Removal of Oxide Film or Scale—The oxide film on metal that has been heated properly is formed during contact with the air after the work is drawn from the furnace. Inconel is an exception—superficial oxidation of chromium will occur during heating in average furnace atmospheres. In all cases where heating has been properly controlled, the oxide film is thin and tightly adherent, has a glossy appearance and is very dark in color. The following procedure will yield good results on oxidized metal carrying a thin to moderately thick, and tight oxide scale:

Two solutions, Formulas No. 5 and No. 6, are required for Monel and "K" Monel. The cupric chloride may be omitted from Formula No. 5 if not readily available, but the pickling process is slow in its absence. After dipping in the first bath, the work should be rinsed in hot water and immersed in the second dip, for brightening. Follow by a rinse in cold water, and neutralization in the ammonia solution described above.

The hydrochloric acid-cupric chloride solution (Formula No. 5) recommended as the first dip for Monel can be used for nickel also, but a longer time, 1 to 2 hr., is required. After the first dip, the work should be rinsed in hot water and, if brightening is required, dipped for a few seconds in the solution of Formula No. 3. Follow by rinsing in cold water and neutralization in the ammonia solution.

There are two procedures recommended for removing oxides from Inconel. For all types of oxide, both thick and thin, Formula No. 7 can be used. If the oxide is thin (greenish chromic acid) a two-dip pickling method is recommended because of the greater ease of handling the solutions. The metal first is dipped in the Formula No. 8 solution, then, without rinsing, it is dipped in the Formula No. 9 solution. After the second dip, the work should be rinsed in cold water and then neutralized.

Paste Pickles—Paste pickles are employed where suitable facilities for pickling in tanks are not available. They fume badly and must be applied in a well ventilated location. If ventilation cannot be provided, fuming will be reduced materially by diluting the acids in the formulas with one-fourth to one-third volume of water.

The treatment outlined in Formula No. 10 is applied to hot-rolled plate, clad plate, forgings, tanks, drawn shells and other large pieces of Monel, "K" Monel, nickel or "Z" Nickel. The lampblack and Fuller's earth are placed in a 5-gal. crock or similar container (larger or smaller container if proportions other than those given are used). The acids are mixed and the cupric chloride dissolved in a separate crock or glass container. The resulting solution is poured over the powder and the whole is mixed thoroughly. If a thinner consistency is wanted, hydrochloric acid may be added in small quantities. If the mixture should be thicker to give a smooth creamy consistency that spreads well with a brush and remains on vertical and overhead surfaces, add lampblack. The paste is applied with a long-handled whitewash brush for large surfaces, or an ordinary paint brush for smaller areas. After the required time, the paste is washed off with a hose, and scrubbed off, if necessary, with sand or pumice. In cold weather, cold wash water will cause Monel to tarnish badly—this can be prevented by spreading a creamy lime paste directly on the pickle paste and thoroughly mixing to neutralize the acid A cold water wash may then be used. Lime is not necessary if hot water is available for washing. Nickel does not tarnish in cold water.

Most oxidized Inconel work requires two paste treatments. First, the paste made up from Formula No. 11 is applied. When the necessary time has elapsed, this paste is removed with hot or cold water and the paste made up from Formula No. 12 is spread on the surface. When the second paste is removed by thorough washing, the surface should be scrubbed with pumice and water, either hot or cold.

Heavily Scaled Work—Scale formed by heating these alloys under improper conditions has a dull spongy appearance; fine hairline cracks may be present, and patches of scale may break away from the surface. The underlying metal is rough and cannot be brought to an attractive finish by any pickling method. Sandblasting or grinding is probably the most suitable procedure, followed by one of the flash pickles described above. An alternative is to soak the work in the hydrochloric acid pickle, Formula No. 5, followed, if brightening is necessary, by a flash dip such as Formulas No. 1 and No. 2 for Monel, or Formula No. 3 for nickel. Inconel must be cleaned with the solution given in Formula No. 7.

Coppering will occur occasionally on Monel, Nickel and Inconel during pickling operations unless proper steps are taken to avoid it. If copper flash occurs, it can be removed readily by immersing the part in an aerated, 4 to 5 percent ammonia solution (about 1 pt. of commercial aqua ammonia to 1 gal. of water) at room temperature. Time required is short, usually only a minute or so. Follow by rinsing in water.

Discoloration—Monel acquires a brown discoloration when machined at high speeds because of the formation of sulphur compounds by reaction with sulphur-base coolants. The discoloration may be removed easily with the solution given in Formula No. 13 to give a white surface. A crock of 1 to 5 gal. capacity, depending on quantity of parts to be cleaned, should be used. Parts can be handled in Monel dipping baskets made of perforated sheet or woven wire. Rinse thoroughly in hot water, if available, or in cold water followed by shaking or tumbling in sawdust to dry. Observe necessary precautions in handling this solution and the stock of cyanide salt—*cyanide is a deadly poison.*

Pickling Hastelloy Alloys—Pickling of the Hastelloy alloys is relatively difficult because of the tenacity of the scale and oxide on the surface. Pickling can, however, be carried out in a solution consisting of 18 parts water, 6 parts concentrated hydrochloric acid and one part concentrated nitric acid. The solution should be heated to about 200 F. The time element for alloys *A* and *B* is much shorter than for alloy *C*, and it is necessary for the operator to watch the pickling operation carefully to prevent etching of the sheet or plate. Usually, about 20 to 30 sec. in the solution is sufficient to remove the scale from alloys *A* and *B*, while alloy *C* must be held in the solution for about a minute to a minute and a half. Sandblasting is preferable for scale removal.

Pickling Illium Alloys—Pickling of Illium is done by dipping in a solution of 10 percent nitric acid and 2 percent hydrofluoric acid at 10 F. for a short time. Occasional scrubbing will facilitate removal of the oxide.

PICKLING FORMULAS FOR HIGH-NICKEL ALLOYS

FORMULA No. 1

Water	1 gal.
Nitric acid (38 Be)	1 gal.
Common salt	0.5 to 0.75 lb.
Temperature	70 to 100 F.
Time	not over 5 sec.

Container—earthenware crocks, glass, or ceramic vessels.

FORMULA No. 2

Water	1 gal.
Nitric acid (38 Be)	1 gal.
Temperature	70 to 100 F.
Time	not over 5 sec.

Container—18-8 stainless steel, glass, or ceramic vessels.

FORMULA No. 3

Water	1 gal.
Sulphuric acid (66 Be)	1.5 gal.
Nitric acid (38 Be)	2.25 gal.

Allow to cool and add:

Common salt	0.25 lb.
Temperature	70 to 100 F.
Time	5 to 20 sec.

Container—earthenware crocks, glass, or ceramic vessels.

FORMULA No. 4

Water	1 gal.
Sulphuric acid (66 Be)	0.75 pt.
Sodium nitrate (crude)	0.5 lb.
Common salt	1 lb.
Temperature	180 to 190 F.
Time	30 to 90 min.

Container—earthenware crocks, glass, or ceramic vessels, or, for short time usage, wooden barrels.

FORMULA No. 5

Water	1 gal.
Hydrochloric acid (20 Be)	0.5 gal.
Cupric chloride	0.25 lb.
Temperature	180 F.
Time	20 to 40 min.

Container—earthenware crocks, glass, ceramic or acid-proof, brick-lined vessels.

FORMULA No. 6

Water	1 gal.
Sulphuric acid (66 Be)	0.1 gal.
Sodium dichromate	1.1 gal.
Temperature	70 to 100 F.
Time	5 to 10 min.

Container—earthenware crocks, glass, or ceramic vessels, or rubber-lined tanks.

FORMULA No. 7

Water	1 gal.
Nitric acid (38 Be)	1 gal.
Hydrofluoric acid (40 percent)	1.25 pt.
Temperature	70 to 100 F.
Time	15 to 90 min.

Container—carbon brick is best.

FORMULA No. 8

Water	1 gal.
Sodium hydroxide (caustic soda)	18 oz.
Sodium carbonate (soda ash)	18 oz.
Potassium permanganate (permanganate of potash)	7 to 11 oz.
Temperature	180 to 190 F.
Time	2 hr.

Container—steel tank.

FORMULA No. 9

Water	1 gal.
Sulphuric acid (66 Be)	0.5 pt.
Copper sulphate or copper nitrate	1.5 oz.
Temperature	180 to 190 F.
Time	1 hr.

Container—wood, earthenware, glass, ceramic, or acid-proof, brick-lined vessels.

FORMULA No. 10

Lampblack	1 lb.
Fuller's earth	10 lb.
Hydrochloric acid (20 Be)	3 gal.
Nitric acid (38 Be)	0.5 pt.
Cupric chloride	1 to 2 lb.
Temperature	70 to 100 F.
Time—	
for Monel and "K" Monel	20 to 60 min.
for Nickel and "Z" Nickel	2 to 4 hr., or longer.

FORMULA No. 11

Lampblack	1 lb.
Fuller's earth	10 lb.
Hydrochloric acid (20 Be)	3 gal.
Cupric chloride	2 lb.
Temperature	70 to 100 F.
Time	1 to 3 hr.

FORMULA No. 12

Lampblack	1 lb.
Fuller's earth	10 lb.
Nitric acid (38 Be)	2.75 gal.
Hydrochloric acid (20 Be)	0.25 gal.
Temperature	70 to 100 F.
Time	15 to 60 min.

FORMULA No. 13

Water	1 gal.
Sodium cyanide	0.5 to 1 lb.
Temperature	70 to 100 F.
Time	5 to 30 min.

Container—earthenware crock or glass.

NOTES:

Mix ingredients in order given. Positive ventilation necessary to protect workmen from toxic fumes from pickling baths. Workmen should wear protective clothing to avoid body burns.

***CAUTION:** Cyanide is a deadly poison and shops not regularly using cyanide solutions should keep the solution given in Formula No. 13 and stock of cyanide salt under lock and key. Under no conditions should acid from pickling operations or other sources be carried into the solution. Acid will liberate hydrocyanic acid gas, probably the most lethal industrial substance.*

MACHINING PRACTICE FOR HIGH-NICKEL ALLOYS

The high strength and ductility of the high-nickel alloys listed on pages 887 to 889 call for machining procedures somewhat different in detail from those employed for metals which are not so tough. Furthermore, the hardness of the wrought and cast forms of the different alloys cover a considerable range. Machinability is particularly good for the free-cutting alloys like "R" Monel and "KR" Monel; reasonably high for such alloys as nickel, Monel, Illium *R* and Hastelloy *A;* and is low for the unusually hard cast "S" Monel, Hastelloy *D* and Illium *G* alloys.

There are combinations of tool shapes, speeds, feeds, and cutting compounds for each of the high-nickel alloys with which good machining results can be obtained. The important considerations are to: (1) use high-speed steel, Stellite '2400' or Star J-Metal, or cemented-carbide tipped tools with sharp cutting edges having a minimum of relief, (2) keep the work well flooded with a suitable cutting compound, and (3) avoid excessive speeds and feeds. *It is important to have a good finish on machined parts which are to withstand corrosive conditions, as torn surfaces sometimes provide focal points for acceleration of corrosion.*

The toughness of the high-nickel alloys, and the high hardness of some of them, tends to cause chattering if the work and the tools are not supported properly. Cutting pressures are higher than for similar machining operations in steel, requiring heavier tools and equipment in good repair.

Feeds, Cuts and Speeds for Machining Nickel and Monel

Operation	*Speed Ft. per min.*	*Cut inches*	*Feed inches*
Turning	45 to 65	1/8 to 1/4	1/8 to 1/4
Drilling	40 to 60	.....	Same as for steel
Milling	50 to 65	.....	.005 to .010 per tooth
Tapping	20 to 25	.....	.....
Thread Chasing	20 to 25	.....	.....
Reaming	25 to 35	.....	Twice drill feed

CUTTING COMPOUNDS

Soluble-oil emulsions generally are satisfactory for turning operations, with rich emulsions (one part soluble oil to 15 or 20 parts water) giving better results than lean mixtures (one part soluble oil to 50 parts water). However, for such operations as boring, drilling, reaming, tapping, threading and broaching, and for screw machine work, more satisfactory results usually are obtained by using sulphurized mineral oils and sulpho-chlorinated mineral oils; in each case with a high percentage of active sulphur. While this is true for most of the high-nickel alloys, the manufacturer of the Hastelloy alloys does not recommend the use of sulphurized cutting oils, suggesting instead, when coolants are desirable, the use of soluble oil, lard oil, or mineral-lard oil. All cutting fluids, *particularly those containing sulphur,* should be removed completely from machined pieces that are to be subjected to high temperatures during fabrication.

TURNING AND BORING

For turning the wrought alloys, front and side relief angles should be about 6 to 8 deg. on roughing tools and from 12 to 15 deg. on finishing tools. Depending on the alloy and the type of cut, side rake angles will vary from about 10 deg. for heavy, dry cutting, to as high as 25 deg. on smaller finishing tools where the amount of metal to be removed is small, the work is well lubricated, and chip disposal is not difficult. A lathe turning tool for nickel, Monel and Inconel alloys with a normal feed and cut should have a front relief of about 8 deg., a side relief of 6 deg., a back rake of 6 to 8 deg., a side rake of 15 deg., and a nose radius of about 1/8 in.

For rough cutting castings, the cutting edge of the tool should be blunter. At the cutting edge it is often advantageous to use an almost perpendicular land of about 1/32 in. width which reduces the end relief at the cutting edge to about 1 to 2 deg. Such a tool will not cut as cleanly as one with a sharper angle, but it is stronger. Tools ground in this manner often are useful when machining the harder wrought alloys, like Inconel and "K" Monel. Lathe tools with such lands must be set "on center" with the work. For turning Illium *G* castings, a high-speed steel tool having a front relief of 5 deg., a side relief of 4 deg., a zero back rake and a 5 deg. side rake has been found to work well when roughing; for finishing, the same tool with a 3-deg. back rake works well. Depth of cut, when roughing castings must be sufficient to always keep the cutting edge below the scale.

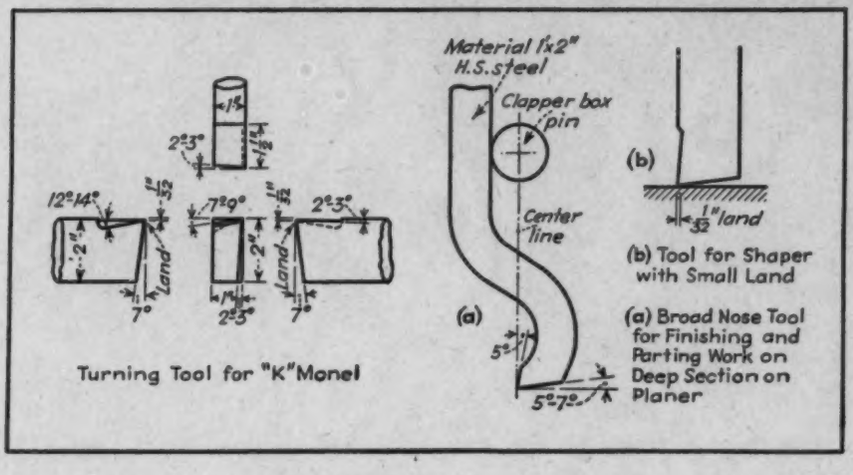
For Hastelloy alloys, roughing tools should be ground with a side relief of 5 to 7 deg. and a front relief of 6 to 8 deg. The side rake should be 4 to 6 deg. for castings and 10 to 12 deg. for wrought material. No back rake is necessary. For finishing, a 10- to 12-deg. side rake is satisfactory for either class of material. In finishing light work, the tool can be ground with a front relief up to 10 deg. and a maximum of 5-deg. back rake to give sharp cutting edges.

When cutting dry with high-speed steel tools, using a 1/8-in. depth of cut and a feed of 1/64 in. per rev. in a

CUTTING FLUIDS FOR NICKEL AND HIGH-NICKEL ALLOYS

Operation	*Cutting Fluid*	
	Monel and Nickel	*Inconel, "K" Monel and "Z" Nickel*
Rough turning	Dry or water-soluble oil	Dry or sulphurized oil
Finish turning	Water-soluble oil	Sulphurized oil
Rough planing	Dry or water-soluble oil	Dry or sulphurized oil
Finish planing	Water-soluble oil	Sulphurized oil
Shaping	Dry or water-soluble oil	Dry or sulphurized oil
Milling	Sulphurized oil	Sulphurized oil
Drilling under 3/32 in.	Turpentine or gasoline	Turpentine or gasoline
Drilling 3/32 to 1/4 in.	Lard oil	Sulphurized oil (cut)
Drilling over 1/4 in.:		
Monel	Water-soluble oil	
Nickel	Sulphurized oil	Sulphurized oil
Threading	Sulphurized oil	Sulphurized oil
Tapping	Sulphurized oil	Sulphurized oil
Boring	Sulphurized oil	Sulphurized oil
Reaming	Sulphurized oil	Sulphurized oil
Cold sawing:		
Low-speed circular saw	Sulphurized oil	Sulphurized oil
Power hacksaw	Water-soluble oil	Water-soluble oil
Power bandsaw	Water-soluble oil	Water-soluble oil
Grinding	Water-soluble oil	Water-soluble oil

TURNING AND PLANER TOOLS FOR MACHINERY "K" MONEL


Material 1"x2" H.S. steel
Clapper box pin
Center line
(b)
1/32" land
(b) Tool for Shaper with Small Land
(a)
(a) Broad Nose Tool for Finishing and Parting Work on Deep Section on Planer
Turning Tool for "K" Monel

standard engine lathe, wrought Monel and nickel can be turned at 110 ft. per min., wrought Inconel and unhardened "K" Monel at 70 ft. per min., cast nickel at 85 ft. per min., while cast Monel and wrought Illium *R* alloys can be turned at 75 ft. per min. Under the same conditions, cast "H" Monel and annealed cast "S" Monel can be turned at 50 ft. per min. with cemented carbide tools and at about 25 ft. per min. with high-speed steel tools; as-cast "S" Monel is turned at about one-half these speeds under similar conditions. If a proper cutting fluid is applied copiously at the cutting tool during the turning operation, all of the above turning speeds can be increased about 20 to 25 percent. The most satisfactory cutting speed for Illium *G* castings is from 20 to 25 ft. per min. For the roughing cut, use a feed of about 0.032 in. with a straight cutting edge on the entire width of the tool set at an angle of 45 deg. so that the tool drags across the work and will not dig in. For finishing, the tool should have a V-point with a nose radius of about 1/32 in.

SCREW MACHINE WORK

The freely machining grades of Monel, commercially known as "R" and "KR" Monel, are desirable for automatic screw machine work. However, in general, automatic machining is not recommended for nickel and the regular grades of high-nickel alloys because of their inherent toughness.

Cold-drawn nickel has been processed in such a machine at 50 to 70 ft. per min. cutting speed on jobs approximately 9/16 in. diameter where the operations consisted of drilling, counterboring, chamfering the outside diameter and cutting-off. Cold-drawn Monel has been run at speeds between 45 and 65 ft. per min., with feeds approximately two-thirds those commonly used for mild steel, on operations involving single-point turning, drilling, reaming and cutoff.

Recommended speeds for automatic screw machine operations on cold-drawn "R" Monel range from 100 to 125 ft. per min. under normal conditions. With unhardened "KR" Monel the machining speed recommended is somewhat lower, usually in the range from 60 to 80 ft. per min. As with lathe tools, screw machine tools for these alloys should be ground with minimum relief angles to provide maximum support for the cutting edge, and with slightly larger rake angles than for steel so as to keep chip pressure, chip abrasion and frictional heat as low as possible. On screw work, it is advisable to avoid too light feeds as the material has a tendency to work-harden and glaze. Tool points must be kept sharp, and always should be cutting when against the work. If allowed to ride on the work without cutting, it is difficult for a tool to "pick up" the cut again. If the material is hard, very little cutting angle should be provided on the tool, and cam dwell should be kept at a minimum, to avoid glazing the work. It is also advisable to have a large top rake angle (as much as 22 deg. for the tougher alloys) on the cutting tools and the side relief angle should be only large enough to permit the tool to enter the work.

PLANING AND SHAPING

The top rake angle of planing and shaping tools is important, in that it can be varied to facilitate chip disposal. The chip should curl over in front of the tool and break when it hits the work. Chips from the high-nickel alloys are very springy—large, heavy chips as they break, or leave the end of the work at the end of the stroke, may fly off at considerable speed. It is best to provide screens to protect nearby workmen.

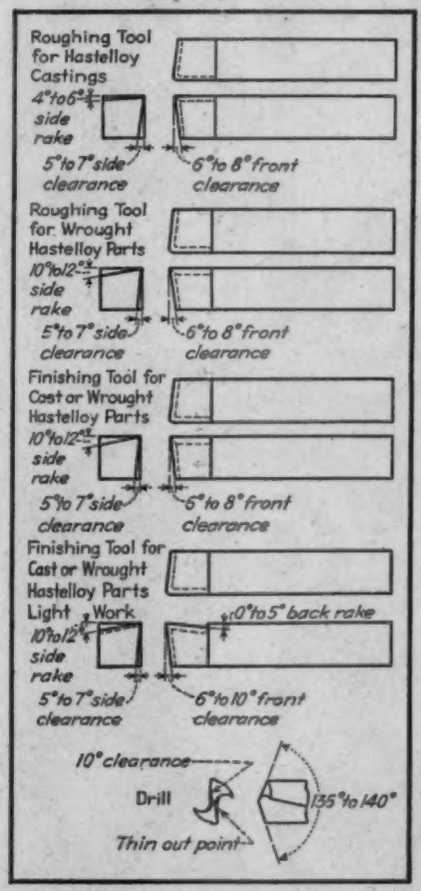
The gooseneck type of planer tool is preferred for finishing cuts, because it throws the center of the cutting edge in line with or behind the center-line of the clapper box pin, and so permits smoother cuts. Roughing cuts should be taken down to within about 0.025 in. of the desired finished dimension, leaving a very light cut for the finishing tool.

Parting of heavy sections on the shaper or planer is done with a blunt-nosed finishing tool, using very light cuts—0.005 to 0.010 in. per stroke—and keeping the tool lubricated by some set-up which will continuously drop oil on the face of the tool.

Cutting oils are not essential for roughing, but should be applied for smooth-finishing cuts. If arrangements cannot be made to drip oil on the tool face for finishing cuts, the work should be smeared with oil before taking the finishing cut. A good soluble oil is adequate for Monel or nickel, but sulphurized oil is needed for Inconel and "K" Monel.

Table speeds of 25 to 35 ft. per min. for Monel and nickel, and 15 to 20

Tool Grinds for Machining Hastelloy Alloys A, B and C


Roughing Tool for Hastelloy Castings
4° to 6° side rake
5° to 7° side clearance
6° to 8° front clearance
Roughing Tool for Wrought Hastelloy Parts
10° to 12° side rake
5° to 7° side clearance
6° to 8° front clearance
Finishing Tool for Cast or Wrought Hastelloy Parts
10° to 12° side rake
5° to 7° side clearance
6° to 8° front clearance
Finishing Tool for Cast or Wrought Hastelloy Parts
Light Work
10° to 12° side rake
0° to 5° back rake
5° to 7° side clearance
6° to 10° front clearance
10° clearance
Drill
135° to 140°
Thin out point

ft. per min. for unhardened "K" Monel and Inconel, have proven satisfactory in shop practice when planing these alloys. About the same cutting speeds are suitable for shaper operations. When roughing, depth of cut should range from $\frac{1}{16}$ to $\frac{3}{8}$ in. with feeds of $\frac{3}{32}$ to $\frac{3}{4}$ in. respectively; while a 0.020 in. depth of cut with a feed of $\frac{11}{32}$ in., or of 0.010 in. width $\frac{1}{8}$ in. feed, works well for finishing.

MILLING OPERATIONS

High-speed steel cutters of either the 18-4-1 type or the cobalt high-speed steel type are essential for milling these materials economically. The milling chip does not break up, but tends to curl. To facilitate chip removal, the cutter should be ground with a 10 to 15 deg. back rake from the cutting edge. Coarse-tooth cutters are preferred, as they have less tendency to chatter. Alternate-tooth or interlocking side mills are best for milling deep holes or for slitting. For very narrow slitting, high-speed steel saws with alternate teeth chamfered, as for cutting copper, work well. These saws are ground concave to provide side clearance. Face-milling cutters with inserted teeth should have appreciable side and top rake. Right-hand mills should have right-hand helix—left-hand mills, left-hand helix.

Surface speed and feed for milling depend to a large extent on the strength and rigidity of the milling machine. Generally, when milling Monel, "KR" Monel and nickel, a cutting speed of 50 to 65 ft. per min. with a feed of 0.005 to 0.010 in. per tooth, depending on the depth of cut, is satisfactory with a suitable set-up. With Inconel and unheat-treated "K" Monel, the surface speed of the cutter must be reduced to about 40 ft. per min. with a feed of from 0.003 to 0.006 in. per tooth. Depth of cut should rarely exceed $\frac{1}{4}$ in. and the average cut is about $\frac{1}{8}$ in. deep. With very light finishing cuts, the above speeds sometimes can be increased as much as 50 percent. For Hastelloy alloys *A*, *B* and *C*, the surface speed with a suitable high-speed steel milling cutter should be about 20 ft. per min. with a feed of from 1 to 2 in. per min. Depth of cut should rarely exceed $\frac{1}{8}$ in. in these alloys. Cutters for milling the Illium alloys should have very small relief and clearance angles. A milling speed of 20 to 25 ft. per min. with a feed of not more than 0.001 in. per tooth usually is best. In milling any of the high-nickel alloys, it is essential that the cutter be kept constantly sharp, and that the work be flooded with a suitable coolant.

SPEEDS AND FEEDS FOR MACHINING HASTELLOY ALLOYS A, B, AND C WITH STELLITE CUTTING TOOLS

Type of Cut	ALLOY A			ALLOY B			ALLOY C		
	Surface Speed, ft. per min.	Feed Per Rev., in.	Depth of Cut, in.	Surface Speed, ft. per min.	Feed Per Rev., in.	Depth of Cut, in.	Surface Speed, ft. per min.	Feed Per Rev., in.	Depth of Cut, in.
Rough-Turn, Face, or Bore	50–60	0.025–0.035	1/16	25–35	0.015–0.030	1/16	30–40	0.020–0.030	1/16
Finish-Turn, Face, or Bore	60–70	0.015–0.020	1/32	30–35	0.008–0.012	1/32	35–50	0.012–0.018	1/32

FEEDS AND SPEEDS FOR AUTOMATIC SCREW MACHINING OF "R" MONEL AND "KR" MONEL (UNHARDENED)

Operation	Width of Cut Inch	Feed In. per Rev.	Cutting Speed Ft. per Min.	
			"R" Monel	"KR" Monel (Unhardened)
Box Tool — Roughing	1/32	0.006	100–125	60–80
	1/16	0.005	100–125	60–80
	1/8	0.004	100–125	60–80
Box Tool — Finishing	0.005	0.010	100–125	60–80
Cut-Off:				
Circular Tool — Straight Tool.	1/16 to 1/8	0.001	100–125	60–80
Stock under 1/8 in. diameter.	....	0.0005	100–125	60–80
Forming Tool — Circular	1/8 to 1/4	0.0006	100–125	60–80
	3/8 to 1/2	0.0005	100–125	60–80
	5/8 to 3/4	0.0004	100–125	60–80
	1	0.00025	100–125	60–80
Balance Turning Tool:				
Turned diameter —				
Under 5/32 in.	1/32	0.006	100–125	60–80
	1/16	0.005	100–125	60–80
Over 5/32 in.	1/32	0.012	100–125	60–80
	1/16	0.010	100–125	60–80

DRILLING OPERATIONS

When drilling any of the high-nickel alloys, it is essential that the feeding pressure be steady, and be sufficiently high to keep the drill cutting at all times. Otherwise the material will polish and work-harden quickly and it will take considerable power to get the drill started again. While ordinarily standard high-speed steel drills are satisfactory for these alloys, "heavy-duty" drills, made with a heavy parallel web and specially heat-treated to provide extra surface hardness, have a longer production life. Such drills can be used at cutting speeds of 50 ft. per min. and more in Monel. While high-speed steel drills of the 18-4-1 type of tool steel are satisfactory for Monel, "R" Monel, "KR" Monel, and nickel, the cobalt super-high-speed steel drills will give appreciably longer tool life in drilling the harder alloys.

Drills ground with the standard 118-deg. point angle and clearance angles of 12 to 15 deg. are entirely satisfactory for most of the alloys. However, it will be found helpful to provide a point angle of 135 to 140 deg. with just enough clearance to clear the work when drilling the harder alloys. The web of the drill should be thinned out at the point, especially when drilling the harder alloys. Reaming with a two-lipped drill after a light cut is not recommended. A three- or four-lipped drill is preferable for sizing a hole. Drilling surface speed ranges from 40 to 60 ft. per min. for nickel, Monel and Illium *R*, to 10 to 15 ft. per min. for Illium *G*.

Oil-hole drills are recommended when drilling deep holes $\frac{3}{4}$ in. in diameter and larger, with the cutting fluid supplied under pressure. These drills should have polished flues and will operate most efficiently when chip breakers are ground in the cutting edges.

REAMING OPERATIONS

Reamers used in the high-nickel alloys must be kept sharp at all times. When drilling a hole that is to be reamed, sufficient metal must be left in the hole to permit the reamer to bite, if it is permitted to ride over the metal the surface will polish and harden to such an extent that the reamer probably cannot be made to cut. With the Hastelloy alloys, not less than 0.012 in. stock should be left for reaming, 0.015 to 0.020 in. is better. For the Illium *G* alloy, not more than 0.0015 in. should be taken at a cut. Helical fluted reamers, made of high-speed steel, with narrow lands and well-polished flutes are recommended. If possible, these tools should have a special heat-treatment to give them a high surface hardness. Reaming operations should not be "pushed," because the metal is apt to tear and wedge between the cutting edges of the reamer. Ordinarily, reaming speeds should be about 60 to 75 percent of the proper speed for a drill made of the same material, and reaming feeds should be two to three times drilling feeds. For the Hastelloy alloys, reaming speeds of approximately twice the drilling speeds are recommended. Adequate lubrication with a proper cutting compound is essential if "digging in" and chattering are to be prevented.

TAPPING OPERATIONS

National standard, high-speed steel, four-fluted plug taps, with ground threads and 7-deg. helical flutes, or four-fluted, spiral pointed plug taps are recommended for machine tapping. The plug taps ordinarily have a four or five thread chamfer, but if the taper can be extended the cutting action will be improved. Solid taps usually are ground with a 15-deg. lip, and with the flutes larger than is normal practice for steel. On taps ¼ in. in diameter and larger, the skip-thread tap gives excellent results.

It is helpful to make allowance for the toughness of the material, by using a tap-drill of slightly larger diameter than the standard commercial tap-drill size, recommended for a specific thread. This will ease the operation without lowering the strength of the thread, since these ductile materials will flow into the root of the tap resulting in threads of the depth specified.

Solid taps should be backed-off—most of the trouble encountered in machine tapping is in backing the tap out of the hole. The tap should not be backed out unless it is free; otherwise a good thread may be torn on the return trip of the tap. When tapping to the bottom of a blind hole, the hole should be tapped first with a tapered tap, then with a plug tap, and finally with a bottom tap. It is necessary that the taps be kept sharp to insure cutting clean threads and to reduce the hazard of broken taps. An adequate supply of a proper cutting fluid is essential to successful machine tapping in high-nickel alloys. If the tap is large enough, a hole should be drilled through it longitudinally so that coolant can be forced into the hole through the tap.

When the diameter is sufficiently large, it is best to use a collapsing type of tap. One manufacturer of such taps recommends a contour type rake for the chasers of collapsing taps used in high-nickel alloys. The contour developed for these chasers allows a free cutting action and curls the chip away from the cutting edge. Another maker of collapsible taps recommends a 10-deg. angle hook for either straight or taper threads in Monel, and a 20-deg. lip hook for straight threads or a 20-deg. radial hook for taper threads in nickel.

As a general rule, fine-pitch taps can be operated at higher speeds than coarse-pitch taps in the same material. Free-cutting "R" Monel may be tapped at 25 to 35 ft. per min. in automatic machines under proper conditions. Monel, unhardened "KR" Monel, Illium *R* and nickel may be machine-tapped at about 15 to 25 ft. per min.; unheat-treated "K" Monel and Inconel must be tapped at a slower speed of about 10 to 15 ft. per min. The harder Hastelloy *A*, *B* and *C* alloys and the Illium *G* alloy are tapped at speeds of approximately 8 to 10 ft. per min.

LATHE THREADING

Threading tools for chasing threads on high-nickel alloys have both back and side rake angles, but these are smaller than are used for turning tools in order to provide support for the small nose of the threading tool. The machine set-up is the same as when chasing threads in other metals. While chasing threads, the work must be flooded with a proper cutting fluid to carry away the heat generated during the operation.

V-threads may be chased in Monel, "KR" Monel and nickel at about 25 ft. per min. and in "R" Monel at 25 to 35 ft. per min. The speed must be reduced to about 15 ft. per min. for the Hastelloy *A*, *B* and *C* alloys, and for Inconel and unhardened "K" Monel. There is no set depth of cut that can be recommended, because the cut will vary, getting lighter as the thread is cut deeper and more of the tool cutting edge is engaged in removing metal. On V-threads, the first few cuts may be turned up 0.025 to 0.030 in. on the compound feed, the cut being diminished gradually until the feed-in reaches a minimum of about 0.005 in. Very light finishing cuts should be taken to insure smooth thread surfaces.

Acme and square threads are machined with the same set-up as for V-threads, but must be cut at slower speeds. About 10 to 15 ft. per min. are suggested for Monel, "KR" Monel and nickel, and 15 to 20 ft. per min. for "R" Monel. A lower speed of 5 to 10 ft. per min. is necessary for the harder alloys. Roughing cuts should start with about 0.015 in. feed-in on the compound and gradually reduced to 0.005 in. for most of the threading. Finishing cuts should be made with no feed-in, relying on the spring of the metal to give the proper depth.

DIE THREADING

Self-opening dies should be employed where external threads are to be produced in quantity. Perfect threads may be cut with solid dies, but such dies frequently are backed-off before they are free and good threads are likely to be torn while reversing the die. Chasers for threading dies should be made of high-speed steel, and usually are ground with more hook than is customary when threading steel. The land must have sufficient clearance to allow the chips to free themselves. Chasers must be kept sharp and flooded with cutting compound. Thread chasing is made easier by turning the stock slightly undersize—0.003 to 0.005 in. undersize being suitable up to about ½-in. diameter and 0.008 to 0.010 in. being sufficient up to 1-in. diameter.

For external threading in high-nickel alloys, a rake angle of 20 to 25 deg. is recommended for wrought materials and 10 to 15 deg. on cast materials. A chaser throat angle of 20-deg. has been found to produce optimum results in threading the wrought high-nickel alloys. For close-to-shoulder threading, a 30-deg. short-throat chaser may be used if the stock is turned undersize as suggested above.

Threading speeds for National Fine and National Coarse standards threads vary considerably. The finer pitches can be threaded at higher cutting speeds than can the coarse pitches as less metal is removed and less heat is generated. Also, the cutting speed depends to a large extent on the throat angle of the chaser used. The lower

SUGGESTED SPEEDS AND FEEDS FOR DRILLING

Drill Size	*Nickel, Monel & "KR" Monel (Unhardened)*		*"R" Monel*		*Inconel*		*"K" Monel (Unhardened)*	
	Approx. Speed Ft./Min.	Feed Per Rev.	Approx. Speed Ft./Min.	Feed Per Rev.	Approx. Speed Ft./Min.	Feed Per Rev.	Approx. Speed Ft./Min.	Feed Per Rev.
1/16	50	0.0015	60–75	0.0020	40	0.0015	25	0.001
1/8	50	0.0025	60–75	0.0030	40	0.0025	25	0.002
3/16	50	0,0030	60–75	0.0035	40	0.0030	25	0.0025
1/4	60	0.0035	60–75	0.0040	45	0.0035	30	0.003
3/8	60	0.0045	60–75	0.0050	45	0.0045	30	0.004
1/2	60	0.0055	60–75	0.0060	45	0.0055	30	0.005
5/8	60	0.0070	60–75	0.0080	45	0.0070	30	0.006
3/4	60	0.009	.....	.....	45	0.009	30	0.007
7/8	40	0.011	.....	.....	30	0.011	20	0.008
1	40	0.013	.....	.....	30	0.013	20	0.009
1 1/4	40	0.015	.....	.....	30	0.015	20	0.010
1 1/2	40	0.015	.....	.....	30	0.015	20	0.010
1 3/4	40	0.016	.....	.....	30	0.016	20	0.011
2	40	0.016	.....	.....	30	0.016	20	0.012
2 1/4	40	0.016	.....	.....	30	0.016	20	0.012
2 1/2	40	0.016	.....	.....	30	0.016	20	0.012
2 3/4	40	0.016	.....	.....	30	0.016	20	0.012
3	40	0.016	.....	.....	30	0.016	20	0.012

throat angle creates a longer cutting edge which, in turn, produces a thinner chip which can be cut faster. Speeds ranging from 15 to 25 ft. per min. have been employed successfully for threading Monel, "KR" Monel and nickel parts, and 10 to 15 ft. per min. for Inconel and unhardened "K" Monel. Free-cutting "R" Monel has been threaded at speeds of 25 to 35 ft. per min. The Hastelloy *A*, *B* and *C* alloys can be threaded at 8 to 15 ft. per min. when short-throat chasers having a 15-deg. back rake are used.

FILING OPERATIONS

Any of the regular shapes and cuts of hand and machine files can be used when filing the high-nickel alloys. However, it is advisable to secure files specially prepared for these materials if they are to be expected to retain their sharpness for a reasonable length of time. In filing, sufficient pressure must be used to keep the file cutting at all times, so that it will not slide over and glaze the work. Usually filing speeds are somewhat slower than for other materials. For fast, effective machine filing, the following points are important: (1) select a file that is coarse enough to permit the chips to fall clear and still produce the finish desired, (2) keep filing speeds low, (3) maintain uniform feed pressure, and (4) *keep the file band cutting at all times*. The file speed should be 50 to 75 ft. per min., depending on the alloy and the file selected. For general filing, a medium-coarse cut tooth usually is best; finishing ordinarily can be done with a fine-cut (24 tooth) file. No coolant or lubricant should be used.

CUTTING-OFF OPERATIONS

When power hacksaws are employed to cut bars, angles, tubing or other shapes of the wrought high-nickel alloys to length, they should be operated at about 60 strokes per minute. High-speed steel blades give satisfactory service when cutting these tough metals. The heavy-duty type of blade with 6 to 10 teeth per inch should be used for cutting bar stock and heavy-wall tubing. The work should be kept flooded with a cutting compound suitable for the material.

Bandsawing with high-speed steel blades of "A" temper quality having 10 to 12 teeth per inch is applicable on all sizes of tubing, sheet and strip, and on bars up to 1-in. diameter. Generally blades having raker-set teeth are recommended. On light-gage sheet and thin-wall tubing wave-set teeth have been found suitable.

On thicknesses of 4 in. and over, saw speed should be 50 to 75 ft. per min. and a 6-pitch saw should be used. From 1 to 4 in., saw speed should be from 50 to 125 ft. per min. with saw pitches ranging from 8 to 12. With material from ¼ to 1 in. thick use a 10 to 14 pitch saw and a saw speed up to about 150 ft. per min., depending on the alloy. On thinner gage materials, make sure that at least one, and preferably two teeth are cutting at all times. Bandsawing speeds for Inconel and "K" Monel usually are about one-half to one-third of those suitable for Monel and nickel. The feed pressure used on these materials is governed by the nature of the alloy, the thickness of the material and the width of the saw. On thick sections the feed pressure may run as high as 75 lb., while on thinner materials a light or hand feed is most satisfactory. The saw should be kept cutting all of the time it is in contact with the material. A cutting compound, properly applied, increases efficiency.

Abrasive cut-off machines using rubber- or resin-bound wheels are quite economical for cutting off lengths from rod and bar stock of all shapes. In general, resinoid-bonded cut-off wheels are used for dry cutting at 9,000 to 16,000 ft. per min. where the cross-section to be cut is relatively large and some burn and burring is not objectionable. Rubber-bonded wheels are employed both for dry and for wet cutting. For dry cutting they are operated at 9,000 to 16,000 ft. per min. where thin wheels are required, the area of contact is relatively small, excessive heat is not generated and burrs must be held to a minimum. Wet cutting, done at 7,500 to 10,000 ft. per min., and submerged cutting at 5,000 to 6,000 ft. per min., are employed where cuts must be smooth, clean and free from burrs. The coolants commonly used for wet cutting are clear water or a mild soda solution. Commercial grinding compounds in proper concentrations are also suitable.

PRECISION GRINDING

Methods of grinding the high-nickel materials are similar to those employed for grinding steel. Grinding wheels employed on these materials must be sufficiently soft to permit a moderate rate of wear. Hard wheels are likely to embed abrasive grains in the surface of the material being ground. In general, silicon carbide abrasive wheels have been found superior to aluminum oxide abrasive wheels for cylindrical and internal grinding operations on these materials, while aluminum oxide wheels generally are better for surface grinding operations. Grinding conditions should be severe enough to yield some wheel breakdown. A roughing cut of 0.0005 and a finishing cut of 0.00025 in. are recommended. A copious stream of a good soluble grinding compound should be flowed continuously on the metal; this is necessary to insure a good finish, keep the wheel from loading, reduce the need for frequent wheel dressing, and to allow grinding to closer limits.

JOINING PRACTICES FOR HIGH-NICKEL ALLOYS

The joining processes (riveting, soldering, brazing and welding) that are widely used for steel are applicable, with some modifications, to the high-nickel alloys. At times several different joining processes may be used in fabricating a single piece of equipment. In general, the highest temperature process should be carried out first and the lowest temperature process last.

RIVETED JOINTS

Holes for the rivets should be subpunched and reamed to size in order to remove material strained in punching, or they should be drilled to size. The holes must be concentric, free from burrs, and true to size. Joints and fittings should be separated for the removal of chips and burrs after reaming the holes. Usually, high-nickel alloy rivets 5/16 in. in diameter and smaller are driven cold. Holes must be completely filled, and the driven head should have the same strength as the shank. These conditions can be met only with rivets of suitable temper properly driven.

When driving high-nickel alloy rivets hot, the same precautions apply as when heating the same alloys for hot working. A proper temperature for driving nickel, Monel or Inconel rivets with pneumatic riveting hammers is 1950 to 2100 F., and for hydraulic riveters 1400 to 1500 F. Where the hydraulic riveters do not have sufficient power to set the rivet properly, the driving temperature must be raised. Nickel and Monel rivets will drive satisfactorily at any temperature between 1400 and 2100 F., but Inconel rivets should be heated to the upper range of 1950 to 2100 F. to avoid the 1600 F. red short point.

Riveted seams in plate must be caulked to close them against leakage. There is no practical difference among Monel, nickel and Inconel, or steel plate in the manipulation or shape of the caulking tool. Care must be taken not to score or damage the lower plate, or to split the caulked plate. Caulk welding may be employed to close riveted joints in plates too thin for tight caulking, and for the protection of the exposed steel in lap joints in nickel-clad plate.

SOFT SOLDERING

Surfaces of metal parts to be soft soldered must be free of any surface oxide or foreign material. Oxide or other tarnish may be removed mechanically by light grinding or polishing with abrasive cloth, or chemically by pickling. Wherever possible, the surfaces to be joined should be pretinned —this can be done with the same solder as that to be used for the joint.

Only those soft soldering fluxes known generally as "acid" fluxes are recommended. Rosin is not suitable since its cleaning action is too mild. The "cut acid" fluxes commonly used for copper are adequate for the soft soldering of Monel and nickel, but a stronger flux is required with Inconel because of its chromium oxide film. "Cut acid" flux for Monel and nickel can be made by adding pure zinc to commercial hydrochloric (muriatic) acid and allowing the reaction to come to equilibrium in the presence of a slight excess of zinc. A small amount of ammonium chloride sometimes is added to improve the fluxing action.

SILVER BRAZING

Low melting point silver brazing alloys are best for joining high-nickel materials—they are essential for Monel, which is subject to intergrannular attack by molten brazing alloys at temperatures above 1400 F. Preferable compositions are those melting at less than 1200 F.; for example Handy & Harman's "Easy-Flo" (50 percent silver, 15.5 percent copper, 16.5 percent zinc, 18 percent cadmium) melts at 1160 F. and flows at 1175 F. The same producer's Grade RT composition (60 percent silver, 25 percent copper, 15 percent zinc), which melts at 1260 F. and flows at 1325 F., fulfills the requirements of special cases calling for a higher silver content. "Handy Flux" is used with both of these brazing alloys. Borax and boric acid fluxes are not useful for silver brazing, since they are not fluid at the temperature levels recommended. Silver brazing alloys containing phosphorous are not recommended for use on high-nickel alloys because of the embrittling effect of this element.

In lap joints that are to be "silver brazed," drive fits should be avoided. Clearances of 0.002 to 0.003 in. that will permit the molten silver alloy to be drawn through the joint by capillary attraction, are recommended. Clearances up to about 0.005 in. still are satisfactory, but excessive clearances of 0.006 to 0.015 in. are wasteful of the brazing alloy and result in low-strength joints.

All foreign material must be removed from the parts before assembly for silver brazing. Flux is applied by brushing a thin film in paste form over the surfaces to be joined. The flux prevents oxidation during heating, dissolves oxides formed during brazing, and assists in flowing out the brazing alloy. Wires of various diameters are used for hand feeding the brazing alloy, or thin sheet or strip cut to shape may be used for preplacing the alloy in some forms of joint.

Parts to be silver brazed are heated by: (1) a manually manipulated oxyacetylene or oxy-city gas flame, (2) placing in an electric furnace, (3) incandescent carbon, (4) electric induction, or (5) dipping in a bath of molten salt. In gas brazing, a neutral or slightly reducing flame is used, and the parts are heated thoroughly to flow out the brazing alloy. If it is desired to restrict the area to be wetted by the brazing alloy, a stop-off paste made of graphite and sodium silicate may be used.

Since the temperatures required for joining with silver brazing alloys are well below those for annealing Monel, nickel and Inconel, the softening effect of brazing is very slight. Heat-treated "K" Monel or "Z" Nickel parts are silver brazed with only a slight local softening. Heat-treatment of these two alloys may be carried out after silver brazing.

OXYACETYLENE WELDING

Good welding is accomplished with the oxyacetylene torch on practically all of the high-nickel alloys in flat, vertical or overhead positions. Corner welds and lap joints may be used where high stresses are not encountered. Butt joints are preferred to lap or corner joints for gas welding these alloys. Beveling is not required for butt joints in material 0.050 to 5/32 in. thick. In thicker material, the sheet and plate edges should be beveled to an angle of 37½ deg. on each side to form V-joints. Both butt and corner edge welds are used for sheet 0.043 in. thick and lighter.

A slightly reducing (carburizing) oxyacetylene flame is recommended with just a little excess acetylene. There should be only a slight feather, no longer than 1/16 in., showing beyond the tip of the luminous cone. With Inconel, care must be taken not to have the flame excessively reducing. A soft flame is preferable to a

harsh flame such as occurs if too small a tip is used. A flux is required for gas welding Monel and Inconel; none is required for welding nickel. The recommended proprietary fluxes do not corrode the high-nickel alloys and need not be removed on this account.

The gas welding of Monel, nickel and Inconel is not a difficult matter when both sides of the joint have been properly cleaned and fluxed, the flame is properly adjusted to the recommended slightly reducing conditions, and the correct filler rod is selected. Monel flows freely from the filler rod into the joint; nickel, which is not fluxed, flows a little sluggishly; while Inconel weld metal is neither sluggish nor very fluid. For best results on these high-nickel materials, puddling should be avoided—the molten pools should be kept quiet, with the tip of the luminous flame just touching its surface.

During oxyacetylene welding, the end of the welding rod should be kept always well within the protecting flame envelope to prevent oxidation of the hot rod material. Welding wires are, in general, of the same composition as the alloy to be welded. Gas welds in "K" Monel, as laid down, have about the same hardness as cast "K" Monel, but are amenable to the usual heat-treatment for wrought "K" Monel to hardness levels of 20 to 23 Rockwell C. On the other hand, while welded "Z" Nickel can be age hardened by heat-treatment, the welds in this alloy are made of nickel welding wire and will not respond to heat-treatment. The joints, however, are ductile and strong.

Hastelloy alloys *A, B* and *C* can be welded readily by the oxyacetylene, electric arc and atomic hydrogen processes. Castings of alloys *A, B* and *C* are generally welded by the oxyacetylene process using a neutral flame and a welding rod of the same composition as the base metal, with the exception that alloy *A* is usually welded with alloy *B* welding rod to give superior corrosion resistance in the welds. Precautions should be taken to maintain a neutral flame to prevent carbon pickup in the weld metal.

Localized preheating is sufficient when welding small castings of Hastelloy alloys *A, B* and *C;* but for larger castings, thorough preheating is advisable to prevent heating and cooling strains. The size and shape of the part to be welded will determine whether preheating is necessary.

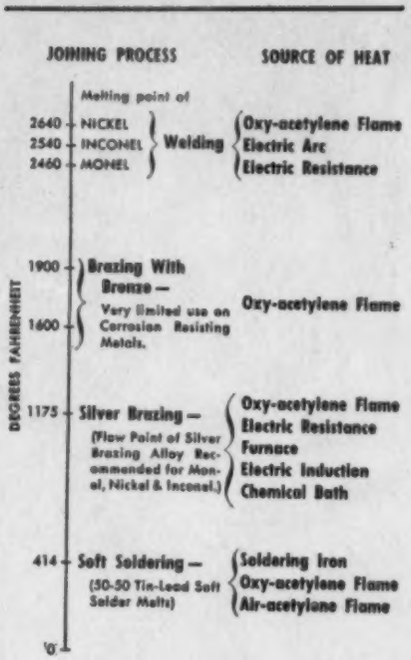
Hastelloy alloy *D* castings can be welded by the oxyacetylene process, using an excess acetylene flame and welding rod of the same composition. Castings to be welded should be gradually preheated to a dull red heat and maintained at this temperature during the entire welding operation. They should then be slowly and uniformly cooled to room temperature in a furnace. During welding, the castings should be supported in such a manner that they can be turned to make the necessary welds while the entire castings are maintained at a uniform temperature.

Castings of Illium *G* alloy that are to be welded by the oxyactylene process should be preheated to 2200 F. The castings should be heated *uniformly* and *slowly,* otherwise severe cracks will result. Welding operations should then be begun, using a carburizing flame. Do not use a neutral flame, since this will cause cracks or increase the size of the pits being repaired by welding. After the weld has been completed, withdraw the torch slowly away from the finished weld, allowing the heat of the torch to keep off any cool air while the welded portion is cooling. If the torch is withdrawn too soon, cold air passing over the weld will oxidize it severely and create a large pit or shrink hole. Any good cast iron flux, preferably one that does not contain borax, may be used when welding this alloy. The welding rod should be of the same composition as the base metal.

ELECTRIC ARC WELDING

The electric arc welding process, using heavily coated shielded-arc type metal electrodes of the same composition as the base metal, is entirely satisfactory for joining practically all of the high-nickel alloys. Carbon arc welding, while not generally recommended, can be used successfully for welding intermediate gages (0.037 to 0.062 in.) of Monel, nickel and Inconel. This method cannot be used with the Hastelloy alloys because of carbon pickup, and consequent lowering of corrosion resistance. When using the carbon arc process, the carbon pencil is oscillated slowly across the seam and the filler rod is dipped into the arc flame to melt off small drops of metal.

The metallic arc welding of Monel, nickel and Inconel closely parallels practices in joint design, layout and welding manipulation employed for making good-quality welds in steel. Monel and nickel can be welded in all positions with the same facility as steel. While Inconel can be welded in any position, best results are obtained when the work is positioned for downhand or flat welding. Direct current motor-generator or rectifier

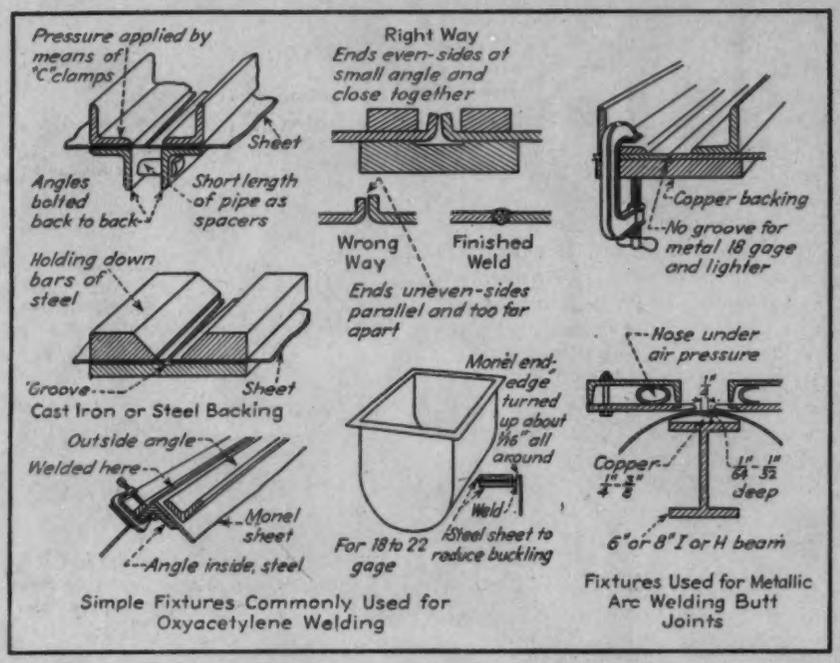


Parent metal temperature required for joining process

type welders are employed for welding the high-nickel alloys—the high-nickel electrodes being used only on reversed polarity, i.e., electrode positive, work negative.

The diameter of the shielded arc electrode should approximate the thickness of the sheet being welded, up to about 3/16 in. For heavier material, either a 5/32 or 3/16 in. electrode can be used. Generally, if the electrode is held in position ahead of the arc—that is, if the electrode is "pulling" rather than "pushing" the arc—and the rod is held at any angle between 30 deg. and vertical, very satisfactory results will be obtained. Maintenance of a uniformly short arc is essential if maximum penetration and protection of weld metal are to be obtained. A slight slow weave across the seam is desirable to insure uniform penetration. On gages ordinarily welded with one or two beads, there is no necessity for preheating, but where castings are to be repair-welded, it is desirable that they be warmed before welding. The melted flux coating, which floats on the surface of the pool of molten metal during deposition, solidifies to a slag which is removed easily by hand tools. When making a multiple-pass "U" groove joint it is important that all flux or slag be removed before laying down each succeeding bead.

When welding Hastelloy alloy *A, B* and *C* sheet and plate with the metallic arc process, special flux-coated



Simple Fixtures Commonly Used for Oxyacetylene Welding

Fixtures Used for Metallic Arc Welding Butt Joints

electrodes are employed and the arc is choked very short. Reversed polarity is used. Precautions should be taken to prevent overheating of the weld metal as this is apt to cause porosity. Some difficulty may also be encountered with porosity in the starting and stopping of the arc. This can be overcome by starting the arc on a tab adjacent to the seam and finishing off the arc on a similar tab.

Illium alloys can be welded with the arc method using Illium welding rod precoated with flux. Best results are obtained with the coldest possible weld. Reversed polarity is used. When welding Illium alloys by the metallic arc or oxyacetylene methods, care must be taken to prevent uneven expansion which will lead to immediate cracking.

ATOMIC HYDROGEN WELDING

With nickel and nickel alloys, the application of the atomic hydrogen process has been limited mainly to the automatic production of welded tubing where a uniform penetration is obtained with a very flat outer surface, no filler rod being added. The process produces sound welds in the Hastelloy alloys when precautions are taken to prevent overheating. In welding Hastelloy alloy *C* sheets, however, the metallic arc method is preferred as this alloy hardens alongside the weld more rapidly than either alloy *A* or *B*. The atomic hydrogen process develops considerable heat and keeps the metal in the hardening range for an appreciable time; any severe tensile strains due to cooling after welding may cause cracking.

The fact that hydrogen has a high solubility in nickel, particularly in the molten state, leads to considerable porosity in welds made in heavy sections. This porosity is usually not troublesome, since it does not extend to the surface of the weld. In thin sections, the gas bubbles break through the surface and are expelled from the weld metal.

RESISTANCE WELDING

Spot, seam and flash welding are applicable to the joining of Monel, nickel and Inconel. These alloys can be resistance welded satisfactorily on practically all types of machines having sufficient power and pressure. Also, these high-nickel alloys can be successfully welded to mild steel, brass, bronze, phosphor bronze, silicon bronze, cupro-nickel, nickel-silver and stainless steel.

The heat for welding Monel and Inconel is obtained easily because of their higher electrical resistance and, since their thermal conductivity is low, the dissipation of heat from the joint is restricted. Nickel has about the same electrical resistivity and thermal conductivity as mild steel. Close control of energy input is essential for the production of consistently high strength welds. In most cases energy input is two to two-and-a-half times that required for mild steel of the same gage. A somewhat higher pressure also is required.

A flat electrode tip gives better results than a dome tip, and the flat tip should have a 30-deg. bevel edge to maintain the diameter of the flat surface. Tip diameters range from $\frac{1}{8}$ in. for 0.025 in. sheet to 5/16 in. for material 0.062 in. thick. On finished surfaces, where depressions would be unsightly, a polished flat copper electrode, about 2 in. square and $\frac{1}{4}$ to $\frac{1}{2}$ in. thick, is used against the side of the joint that is to be finished. Spot welding tips that have less than about 25 percent of the thermal conductivity of copper should not be used, because of their tendency to overheat.

Energy input is necessarily greater for Monel than for steel because the resistivity of Monel requires higher secondary voltages to produce the necessary current. The amount of upset should be sufficient to eliminate completely molten metal from the weld. Any further upset is unnecessary and results in forming cold metal which may distort the joint. It is essential that the push-up be started immediately before the current is interrupted to obtain the best welds. Push-up should come during the last two cycles of current flow. If it comes after the current cut-off there is likely to be some trapped cast metal in the weld as well as trapped oxide. If much longer than two cycles of current is passed after push-up, the metal will be overheated during this butting condition with pinholes and intergranular melting as a result. The welds produced may be of poor quality and lowered strength.

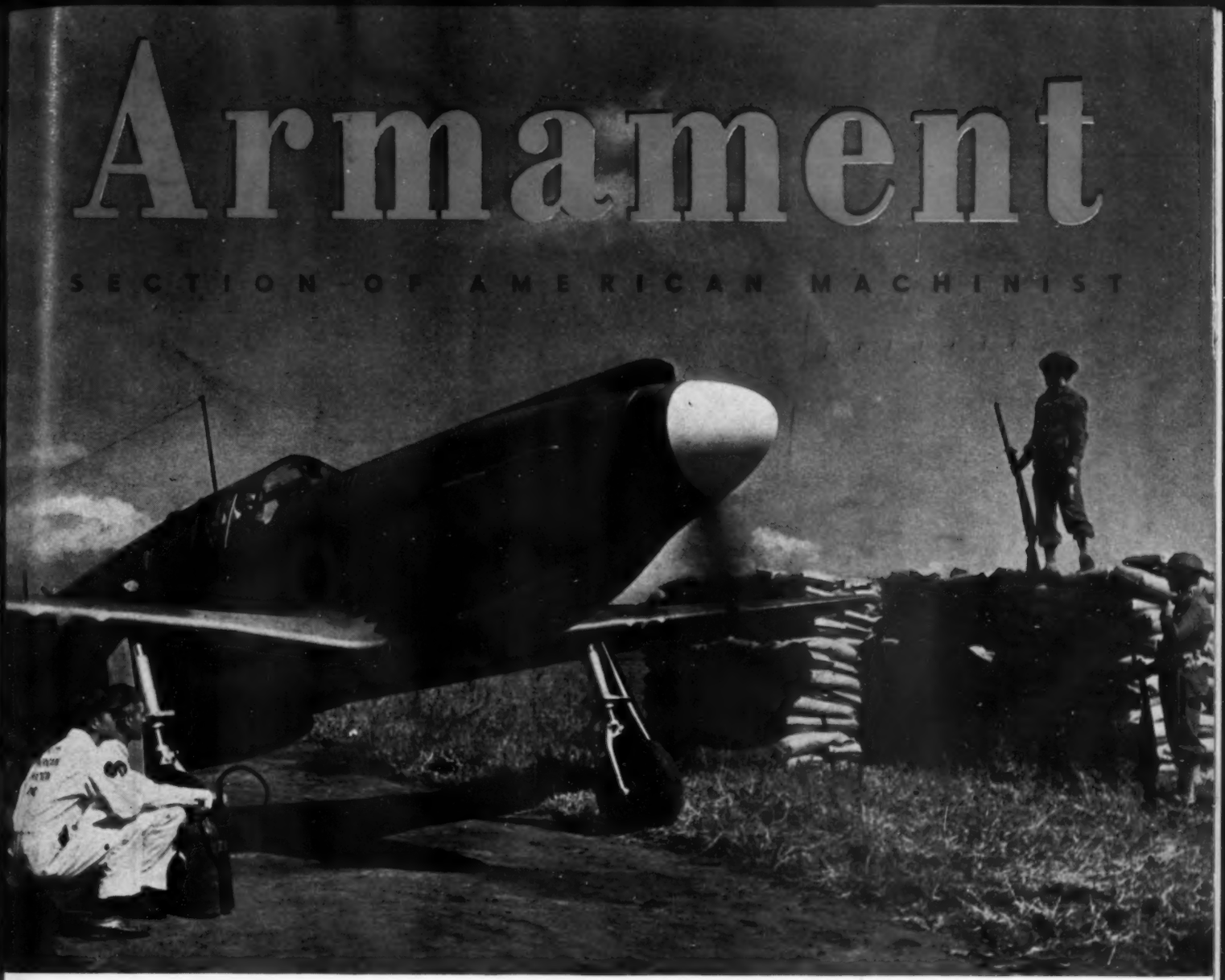
WELDING FIXTURES

Properly designed welding fixtures to align and hold in position the edges to be welded by the oxyacetylene or metallic arc processes facilitate the welding of sheet sections of the high-nickel alloys. When designing fixtures for gas welding, it is necessary to provide either a groove under the joint, or to have an open fixture. The groove serves as a mold for weld metal and thus provides for uniform penetration. The absence of a groove or space below the joint will make welding difficult. Steel or cast iron are commonly used for gas welding fixtures.

Fixtures for metallic arc welding are similar in design to those most suitable for gas welding, and feature a groove to permit penetration of the weld metal. Grooves should be extremely shallow, usually 1/64 to 1/32 in. maximum depth, and 3/16 to $\frac{1}{4}$ in. wide. Flat surfaced steel or copper backing bars are not recommended for butt joints in 0.050 in. or thicker material, because of the possibility of trapping flux at the bottom of the weld. Backing bars for arc welding should be made of copper; hold down bars may be either copper or steel.

Armament

SECTION OF AMERICAN MACHINIST



SMART TOOLING SPURS THE MUSTANG

By GARY STROH

Superintendent of Final Assembly, North American Aviation, Inc.

NORTH AMERICAN'S MUSTANG (P51), so christened by the R.A.F., which first used this fast fighter, is a low-wing single-seater powered by an Allison 1,150-hp. liquid-cooled engine. It has a wing spread of 37 ft. 5 in., and an over-all length of 32 ft. The Mustang is the only fighter in the world equipped with the airflow wing developed by the National Aeronautical Society at Langley Field, Va. Good news comes from Europe of its maneuverability in combat.

The first Mustang was completed just 100 days after its designers put their pencils to the drawing board. Since then tools and assembly lines have been completed, putting this ship into all-out production.

The Mustang method of manufacture is built around three major subassemblies: the fuselage, the wing section and the motor. These in turn are broken down into many minor subassemblies, built up on jigs so that as much work as possible can be handled in small units.

The key to the method of production is the North

This article has been reviewed and approved by the proper military authorities

Rivet boxes, compressed air and electric outlets are built into the Mustang fuselage jig

Trunnion-mounted stands permit rotation of the tail cone for the assemblyman's convenience

American technique of jig design. All assembly jigs are painted a light ivory color which affords good contrast to the work and promotes cleanliness and safety in the shop. The jigs are wired for electricity and piped for compressed air to provide convenient outlets for portable tools. They also contain holsters for storing these tools when not in use, as all portable equipment is part of the jig and stays with it at all times.

Another convenience of North American jigs is the use of rivet boxes conveniently attached to the frame. These boxes have compartments for holding rivets of various sizes.

Each jig has the jig number and the number of the part to be built in it on a plate attached to the frame. In addition, space on the plate is left for recording the dates that the jig was moved and the dates of alignment including the inspector's stamp.

In order to make the jigs as productive as possible, only enough work is done in them to make the subassembly sufficiently rigid to be removed from the jigs. Then the subassembly goes to a supporting frame in which the remaining work, or "pick-up" operations, are performed.

Sheet metal and extruded parts come to the assembly department preformed and in many instances made up into minor subassemblies. Skin sections are also preformed and drilled with small pilot holes that are enlarged to rivet size by drilling through the skin and the supporting member when the two are joined together in the jig.

The fuselage consists of two main sections: the forward section and the tail. The forward section is built in three parts, the two side sections and a top section; each part has its own assembly jig. These jigs are provided with standard toggle clamps for holding the work in place. Such clamps are common to all North American jig designs.

Formed members of the jig fit the extruded longerons to give them positive location. The fore and aft location is provided by means of pins. All clips and fittings are installed on the longerons in previous departments.

In locating the subassemblies in all jigs, use is made of key points, fixed by carefully tooled holes which fit pins in the jig. For instance, the fuselage sections are located from the main wing attachment fittings at one end and from the motor mounting points at the other end.

The ribs, stringers and other sheet-metal components come to the assembly prefabricated and are in turn located on the jig. Then the skin sections are added, located end-wise by means of stops on the jig. They are held in place by Cleco fasteners while the holes are drilled and riveted. When a sufficient number of rivets have been driven by means of portable air hammers, the fuselage section is transferred to a pick-up station where the balance of the structural work is completed.

After subassembly, these sections are given prime and finished coats of paint on their inside surfaces. A separate jig is used for the overturn truss, a structural member designed to protect the pilot in the event of a ground loop.

Another jig is used for the tail cone on which the general procedure followed with the forward fuselage section is employed. The tail cone is then transferred to a trunnion fixture where it can be turned to any convenient angle for the "pick-up" work.

An interesting feature of North American jig design is the large number of auxiliary jigs, or "apply" jigs, as they are called, used in conjunction with the main jig. These apply jigs locate openings and cutouts of various kinds. While they are loose parts of the main jig they are located from it when in use and provide a means of drilling and assembling components at various angles which would be impractical if the means for doing so were rigidly attached to the jig proper.

The master jig for assembling the tail section cone has a heavy cast end frame to insure rigidity. The use of castings in combination with structural shapes is widely employed by North American to add stability to the set-up.

The bottom section of the fuselage is combined with the sides and top sections in a four-wheeled dolly.

ORCHIDS FOR THE MUSTANG

A recent Associated Press release reports the following tribute paid by the RAF Fighter Command to the Mustang:

"The Mustangs are likely to bear the brunt of low-altitude fighting in any Allied invasion of the continent.

"Americans certainly did us a good job on these Mustangs. They are the only American day fighters now operated by the RAF. They have been assigned to the Army cooperation group and have been used for low-level attacks on ground targets in occupied France.

"In a recent operation one Mustang ran into a German balloon cable which cut a wing almost in half. But the plane got back to its base, whereupon the pilot stepped out and reverently kissed the machine.

"Another Mustang was hit by an anti-aircraft shell which exploded a munitions box, damaging wings and sent splinters flying over the fuselage. This machine also got home."

Here the tail cone is also added, located by the holes previously drilled in the jig. Any touch-up painting that is required on the interior surfaces is done at this time.

At this point, the subassembly is structurally complete. For installing the various electrical and hydraulic controls that go into the fuselage the subassembly is transferred from the dolly to an overhead trolley conveyor. The forward end of the fuselage is provided with a lift tube which extends transversely across it and through which a bar can be passed from one side to the other. The carriage supported on the overhead trolley has four vertical arms, two of which support the assembly at the forward end by means of the lift bar while the other two connect to the wing fittings at the rear.

The fuselages are carried along in two identical lines through 15 work stations in each line. They progress at a 45-deg. angle which conserves working area. At each station extensions on two of the vertical arms are connected to the floor to stabilize the assembly while work is being done on it.

All the installations have been subassembled and completely wired before reaching the assembly line. For instance, the rudder pedals with hydraulic brake cylinders in place come to the line as one unit.

All operations at each station are pre-planned. A schedule is attached to the fuselage at the beginning of the line, giving the starting date, the date scheduled at each work station and the date inspected.

"Sign-off" Sheets Carried With Assembly

This schedule also includes "sign-off" sheets which list in detail all operations to be done on the subassembly. The operations are checked off by the mechanic who does the work, by the leadman, by the company inspector and by the customer's inspector. Each item listed gives the part number of the piece or subassembly installed and a brief description of it. The schedule and "sign-off" sheet go with the subassembly to final assembly and after completion of the plane remain as a permanent record of inspection.

Along the inside of the assembly lines racks and Rotobins are provided for the raw stock of standard parts and for small components. Subassemblies feed into the line at the proper time for installation.

The fire wall comes to the line subassembled with oil lines and electrical junction boxes in place. The landing gear fairing, retract strut, and Prestone overflow tanks, cable assemblies and bulkhead fittings have previously been added. Holes in the fire wall are transferred to the fuselage section and the two members are bolted together.

Cable assemblies are installed in the tail cone in a separate department. This unit is bolted into place with very little installation on the line. However, cables must be fed through the entire fuselage requiring the addition of pulleys and fair leads.

At Station 15, the fuselage is lifted from the overhead trolley by chain falls and set on a dolly. The lift tube and the upper motor mount attachment fitting are used to make the transfer.

At this point the fuselage subassembly is completed. It will be left here for the present in order to trace the progress of the two other major subassemblies.

Wing Edges Fabricated Separately

The leading edge and the trailing edge of the wings are made as subassemblies. Here the general practice used in making the fuselage sections is employed. Separate jigs are used for each subassembly. The two parts are then set together while the ribs are riveted and the center skin section is added.

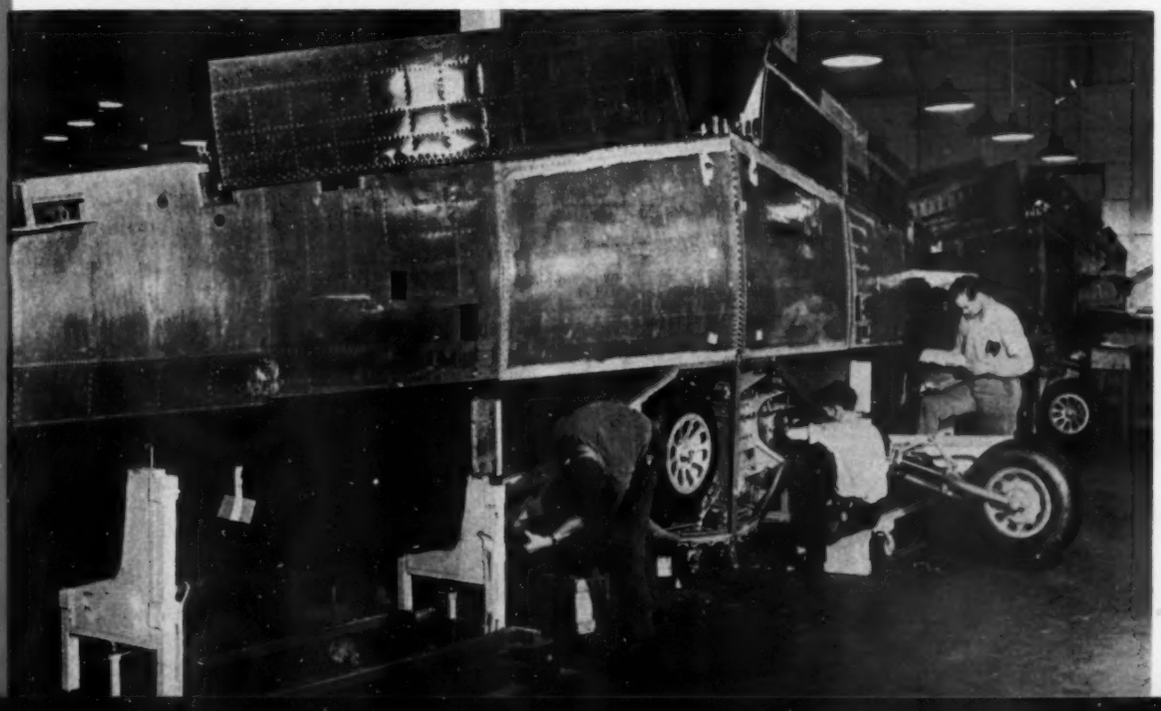
In assembling the wings, the main shear spar is held in the jig. The leading and trailing wing sections are located by the aileron hinge bracket and flap hinge bracket using pins in the jig. The leading edge is held by the end rib and the landing gear casting. As in the case of fuselage assembly, apply fixtures are used for adding the fittings. The end plates of these jigs are made of cast iron supported on steel I-beams below the floor level.

The wings are then mounted on dollies and moved longitudinally down the floor for the various installations that go into them. These dollies are guided by a track in the floor. They move through six stations with platforms between the lines at the first four stations so that the operators can work in more convenient posi-

Supported on overhead trolleys and steadied by floor pins, fuselages move along the first section of the assembly line

As they leave the overhead work supports (in the foreground), Mustang fuselages are transferred to wheeled dollies on the final section of the line

Wings are joined in pairs on special carriages, while landing gear and other installations are added



With wings and Allison engines in place, Mustangs get final fitting and inspection

Hydraulic and other controls are checked with the plane supported on wing jacks

tions. It is possible to perform operations on both the inside and outside of the wing at one time by this arrangement.

One line is devoted to left wing and the other to the right, although they do not necessarily have to travel in mating pairs.

Landing gear struts are assembled on a four-sided fixture located in a side bay. The assemblies are clamped by the oleo strut and can be rotated horizontally or vertically to aid the operator.

Paralleling the wing assembly line are trays and bins for the small components and stock parts. At Station 3, the wing tips are added and wooden frames painted red are strapped over them to protect them in handling. The hydraulic lines are also installed at this station, and the gun bays are insulated.

At Station 4, the heater, blast tubing and electric junction boxes are installed in the gun bays.

At the last two stations, there are no work platforms as all the operations can be reached from the floor. The flaps and ailerons are added here, and the hydraulic and the electrical lines are completed. At each station along the wing line, the dollies are locked to the floor to provide stability during assembly.

After the wings leave the line, they are taken to another department on the same dollies where the right and left wings are bolted together and the final installations made. These dollies are adjustable vertically to provide convenient working heights for the various operations.

In this department the retractable landing gear is added, and the latex seal-proof gasoline tanks are fitted to the wings. The control stick is installed, and the ailerons are rigged.

The wings are carried on these dollies by the fuselage attachment fittings. When the last installation has been made the wings, now united in one section, are carried on the same dollies to the final assembly lines.

Allison engines, with which the Mustang is powered, are shipped from the engine manufacturer covered with slushing grease. In the receiving department this grease is cleaned off by steam.

The motors are mounted on special dollies by their usual attachment fittings and are carried along a line sidewise while the accessories, such as spark plugs, pumps and carburetors, are installed. This line has ten stations.

The engine mounts are received subassembled. They are combined with the engine in this line.

Then the engines and mounts are put on high dollies to which they are transferred by means of a chain hoist. They progress intermittently through twelve stations along a U-shaped line. The engines are carried head on along this line, which is used for installing the cowling. Again racks for stock parts and components are located on either side of the assembly line. Coming off this line, the engine is ready to be transferred to the final assembly station.

Thus far the progress of the three major subassemblies along their respective lines has been traced. The fuselage, mounted on the dollies at the beginning of the final assembly line, is at the first of six stations. At this station the empennage assemblies are installed.

Fuselage Mated to Wing Section

At the second station, the fuselage is again lifted on chain hoists and mated with the wing section which is carried on its own landing gear. The rear end of the fuselage still rests on a dolly, supported by a bar through the lift tube. The engine is installed at this station. Here, also, the hydraulic lines from the wing assembly are connected to the fuselage, and the engine controls are brought back to the fuselage. No jig is required for the mating operation since the fittings which connect the main subassemblies, are all jig-drilled and provide locating points.

The sign-off sheets for the three subassemblies are all combined on the plane at the mating station. The leadman gets an O.K. from the inspector before the wing is installed.

The radiator for cooling oil and Prestone is installed. This radiator is carried on a low dolly from which it can be cranked up by a small hoist into the under side of the fuselage. The tail fairing which has already been formed is installed at this point.

In the last three stations of the main assembly line the plane is rigged and checked. The engine installation is completed and the controls tested. A hydraulic test stand is provided which contains a reserve supply of hydraulic fluid and carries the pump driven by a 5-hp. motor. By means of this the hydraulic system is tested for leaks and all valves are inspected. These tests include the operation of the landing gear and tail wheel, the landing flaps and the scoops for controlling the flow of air through the radiator. Wing jacks are provided to lift the plane while the landing gear is tested. The throw of the various mechanical controls and the cable tension is also checked.

At Station 5, the ship is turned over to the inspector who passes it if everything is O. K. and seals all removable parts. At Station 6, final adjustments are made and the last cover plates, including all cowling, are fitted.

The Mustang is then delivered to the Flight Department on the landing field where the engines are given a test run. One plane out of 20 is flown. The oil, gas and Prestone are drained, and the systems are flushed out. The final coat of paint is sprayed on in the open, making the Mustang ready for shipment overseas.

In pressing the button which started the belt moving, the leadman opened a period of increased production in the departments served by this conveyor

Belt Conveyor Helps Beat the Axis

AS AIRCRAFT PRODUCTION SCHEDULES climb higher and higher, the mechanization of material handling becomes increasingly essential. Powered assembly lines are now widely used in the industry, for final assemblies and for the major subassembly of wings and fuselage. The trend moves a step further in the adaptation of mechanized lines to minor subassemblies.

A good example of this is a moving belt conveyor used by the Douglas Aircraft Company. The line consists of a 36-in. wide endless canvas belt which is carried over rollers to a length of several hundred feet. Scores of different subassemblies for fighting planes and military transports are handled on it.

Use of the line establishes a steady planned flow of work. It avoids backtracking and other causes of delay found when tools and jigs are placed in a less logical departmental arrangement.

Overhead, down the center of the line, an electrical conduit and a compressed air line carry conveniently spaced outlets for rivet guns and electric drills. On either side, just above the sides of the belt, two racks carry hooks for suspending these portable tools when not in use. The tools are part of the line; this arrangement eliminates the use of a toolcrib for storing them and saves the time consumed in checking tools in and out.

Paralleling the line on either side are jigs for positioning the aircraft components and the riveting, dimpling and other machines needed to transform the parts into subassemblies. These machines are so placed that their operators can take work from the line and return it again without leaving their work stations. Benches are located at 90 deg. to the belt with an eye to convenience and the avoidance of lost motion.

Such widely assorted parts as cockpit inclosures, pilot's seats, troop benches and metal flooring are carried along the belt conveyor.

Parts starting the line bear a yellow tag designating the stations at which they must be taken off and the work to be done on them. Each man is given a schedule at the start of the shift telling him the parts he is to work on and the time the materials will arrive on the belt. Production illustrations of a type developed by Douglas are kept at each work station and enable the operator to visualize the operations he is to do.

The line is driven by a 3-hp. motor through reduction gears. It moves slowly but steadily.

In addition to its value in material handling, the line has promoted efficiency by enabling the work to be broken down into specialized steps. Each man is able to concentrate on a limited number of operations and to become proficient at them. This breakdown is especially advantageous in training comparatively unskilled workers who are able to become productive more quickly through the use of the conveyor.

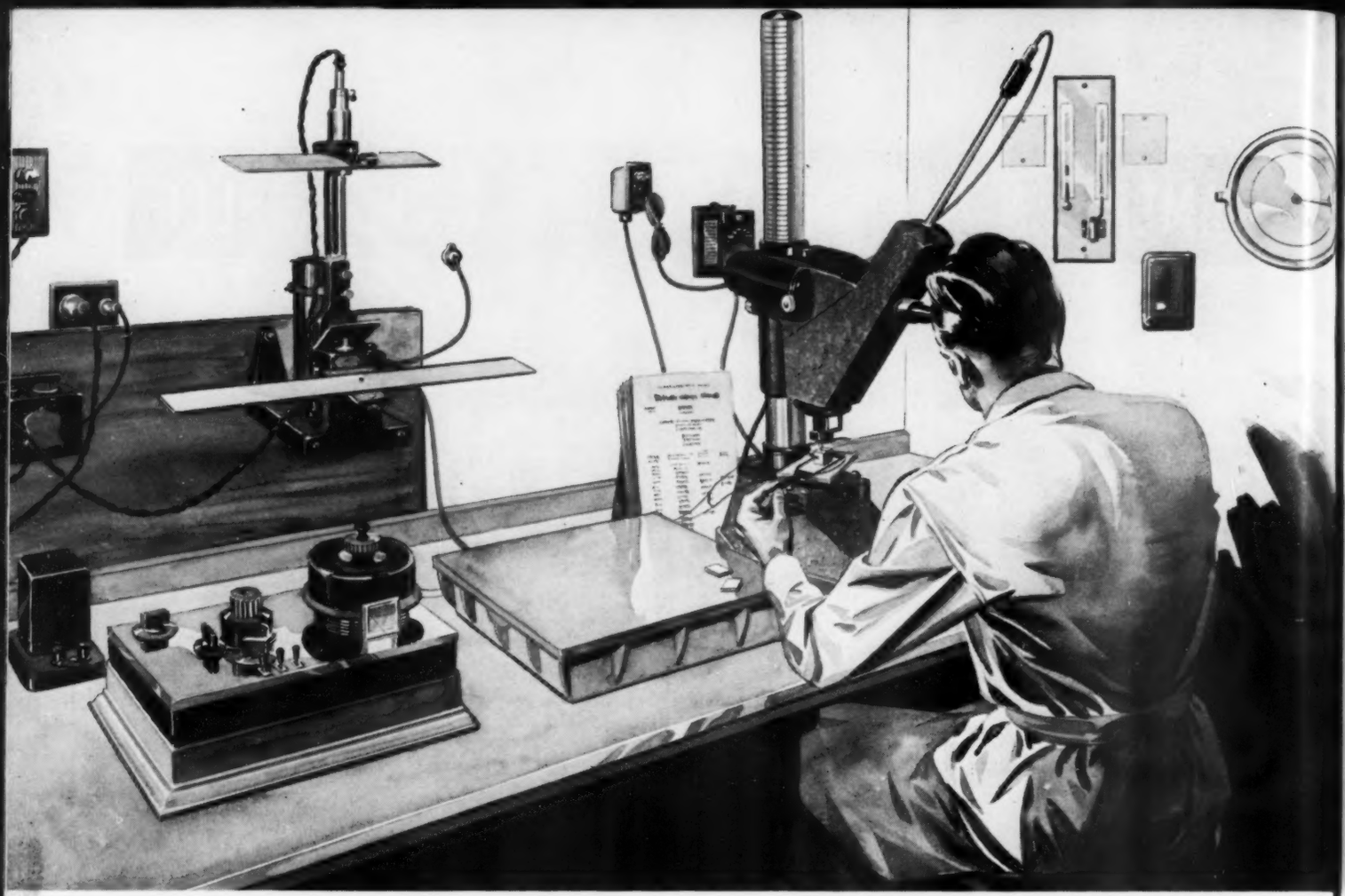
An inspector stationed at the end of the belt examines all parts before they are placed in trailer cars for delivery to the major assembly lines. Other inspectors at the work stations along the conveyor watch the work in progress. There has been a notable decrease in spoilage since this method of handling was installed.

Recommended Tap Drill Sizes—III

SIZES OF TAP DRILLS, AMERICAN NATIONAL COARSE-THREAD SERIES

Size of thread	Threads per inch	Minor diameter of nut			Stock drills corresponding to 100 percent to 50 percent of basic thread depth		
		Basic	Maximum	Minimum	Nominal size	Diameter	Percent of depth of basic thread
					29.5 mm	*1.1614*	*99*
					1 11/64	*1.1719*	*94*
					30 mm	*1.1811*	*90*
					1 3/16	*1.1875*	*87*
					30.5 mm	1.2008	80
					1 13/64	1.2031	79
1⅜	6	1.1585	1.2126	1.1946	*1 7/32*	*1.2188*	*72*
					31 mm	*1.2205*	*71*
					1 15/64	*1.2344*	*65*
					31.5 mm	*1.2402*	*62*
					1 1/4	*1.2500*	*58*
					32 mm	*1.2598*	*53*
					1 17/64	*1.2656*	*51*
					1 19/64	*1.2969*	*94*
					33 mm	*1.2992*	*93*
					1 5/16	*1.3125*	*87*
					33.5 mm	*1.3189*	*84*
					1 21/64	1.3281	79
					34 mm	*1.3386*	*75*
1½	6	1.2835	1.3376	1.3196	*1 11/32*	*1.3438*	*72*
					34.5 mm	*1.3583*	*65*
					1 23/64	*1.3594*	*65*
					1 3/8	*1.3750*	*58*
					35 mm	*1.3780*	*56*
					1 25/64	*1.3906*	*51*
					38 mm	*1.4961*	*98*
					1 1/2	*1.5000*	*96*
					1 33/64	*1.5156*	*90*
					38.5 mm	*1.5157*	*90*
					1 17/32	*1.5312*	*84*
					39 mm	1.5354	83
					1 35/64	1.5469	78
1¾	5	1.4902	1.5551	1.5335	39.5 mm	1.5551	75
					1 9/16	*1.5625*	*72*
					40 mm	*1.5748*	*67*
					1 37/64	*1.5781*	*66*
					1 19/32	*1.5938*	*60*
					40.5 mm	*1.5945*	*60*
					1 39/64	*1.6094*	*54*
					41 mm	*1.6142*	*52*
					43.5 mm	*1.7126*	*100*
					1 23/32	*1.7188*	*97*
					44 mm	*1.7323*	*93*
2	4½	1.7113	1.7835	1.7594	*1 47/64*	*1.7344*	*92*
					1 3/4	*1.7500*	*87*
					44.5 mm	*1.7520*	*86*
					1 49/64	1.7656	81

Size of thread	Threads per inch	Minor diameter of nut			Stock drills corresponding to 100 percent to 50 percent of basic thread depth		
		Basic	Maximum	Minimum	Nominal size	Diameter	Percent of depth of basic thread
					45 mm	1.7716	79
					1 25/32	1.7812	76
					45.5 mm	*1.7913*	*72*
					1 51/64	*1.7969*	*70*
					46 mm	*1.8110*	*65*
2	4½	1.7113	1.7835	1.7594	*1 13/16*	*1.8125*	*65*
					1 53/64	*1.8281*	*60*
					46.5 mm	*1.8307*	*59*
					1 27/32	*1.8438*	*54*
					47 mm	*1.8504*	*52*
					50 mm	*1.9685*	*98*
					1 31/32	*1.9688*	*97*
					1 63/64	*1.9844*	*92*
					50.5 mm	*1.9882*	*91*
					2	*2.0000*	*87*
					51 mm	*2.0079*	*84*
					2 1/64	2.0156	81
					51.5 mm	2.0276	77
2¼	4½	1.9613	2.0335	2.0094	2 1/32	2.0312	76
					2 3/64	*2.0469*	*70*
					52 mm	*2.0472*	*70*
					2 1/16	*2.0625*	*65*
					52.5 mm	*2.0669*	*63*
					2 5/64	*2.0781*	*60*
					53 mm	*2.0866*	*57*
					2 3/32	*2.0938*	*54*
					55.5 mm	*2.1850*	*97*
					2 3/16	*2.1875*	*96*
					2 13/64	*2.2031*	*91*
					56 mm	*2.2047*	*91*
					2 7/32	*2.2188*	*87*
					56.5 mm	*2.2244*	*85*
					2 15/64	2.2344	82
					57 mm	2.2441	79
2½	4	2.1752	2.2564	2.2294	2 1/4	2.2500	77
					57.5 mm	*2.2638*	*73*
					2 17/64	*2.2656*	*72*
					2 9/32	*2.2812*	*67*
					58 mm	*2.2835*	*67*
					2 19/64	*2.2969*	*63*
					58.5 mm	*2.3031*	*61*
					2 5/16	*2.3125*	*58*
					59 mm	*2.3228*	*55*
					2 21/64	*2.3281*	*53*



HE'S WORKING AGAINST *Infinity!*

Most inspectors work to specified tolerances of .001–.0001, etc. Not the one you see above. He's inspecting WEBBER GAGE Blocks and he's working against *infinity!*

For example the instrument he is using is only one of many required in testing Webber Gages. The room in which he works is kept at a constant temperature and humidity by means of thermostatic control. Room temperature is charted by a recording thermometer on the wall. A wet and dry bulb thermometer indicates humidity. The gage being inspected and the master gage temperatures are being recorded by means of a potentiometer and galvanometer as shown.

Every gage block he helps to produce is guaranteed accurate within .000004" (4 millionths of an inch)—every gage block is checked under perfect conditions with every known precision instrument. But that's not good enough!

Webber "technicians in precision" are constantly striving to achieve absolute perfection—and perfection in gage blocks is measured against infinity.

Today Webber's every resource in experience, manpower and ultra-modern manufacturing facilities is being thrown into the task of meeting wartime demands for gage blocks. Although quantity is being fantastically increased, *quality* is being improved. We're still working against infinity! Write for full descriptive bulletins.

•

Webber
GAGE COMPANY
12901 TRISKETT RD., CLEVELAND, OHIO

•

To meet wartime demands WEBBER's entire productive capacity is being devoted to the manufacture of GRADE A GAGE BLOCKS only.

•

Prompt delivery to firms furnishing necessary priority certificates. Prices for Set No. 81A—$350.00. Set No. 40A—$185.00.

•

Recommended Tap Drill Sizes—IV

SIZES OF TAP DRILLS, AMERICAN NATIONAL COARSE-THREAD SERIES

Size of thread	Threads per inch	Minor diameter of nut			Stock drills corresponding to 100 percent to 50 percent of basic thread depth		
		Basic	Maximum	Minimum	Nominal size	Diameter	Percent of depth of basic thread
					2 7/16	2.4375	96
					62 mm	2.4409	95
					2 29/64	2.4531	91
					62.5 mm	2.4606	89
					2 15/32	2.4688	87
					63 mm	2.4803	83
					2 31/64	2.4844	82
					63.5 mm	2.5000	77
2¾	4	2.4252	2.5064	2.4794	2 1/2	2.5000	77
					2 33/64	2.5156	72
					64 mm	2.5197	71
					2 17/32	2.5312	67
					64.5 mm	2.5394	65
					2 35/64	2.5469	63
					65 mm	2.5590	59
					2 9/16	2.5625	58
					2 37/64	2.5781	53
					65.5 mm	2.5787	53
					68 mm	2.6772	99
					2 11/16	2.6875	96
					68.5 mm	2.6968	93
					2 45/64	2.7031	91
					69 mm	2.7165	87
					2 23/32	2.7188	87
					2 47/64	2.7344	82
					69.5 mm	2.7362	81
					2 3/4	2.7500	77
3	4	2.6752	2.7564	2.7294	70 mm	2.7559	75
					2 49/64	2.7656	72
					70.5 mm	2.7756	69
					2 25/32	2.7812	67
					71 mm	2.7953	63
					2 51/64	2.7969	63
					2 13/16	2.8125	58
					71.5 mm	2.8150	57
					2 53/64	2.8281	53
					72 mm	2.8346	51
					74.5 mm	2.9331	98
					2 15/16	2.9375	96
					75 mm	2.9528	92
					2 61/64	2.9531	91
					2 31/32	2.9688	87
3¼	4	2.9252	3.0064	2.9794	75.5 mm	2.9724	85
					2 63/64	2.9844	82
					76 mm	2.9921	79
					3	3.0000	77
					3 1/32	3.0312	67
					3 1/16	3.0625	58
					3 3/16	3.1875	96
					3 7/32	3.2188	87
3½	4	3.1752	3.2564	3.2294	3 1/4	3.2500	77
					3 9/32	3.2812	67
					3 5/16	3.3125	58
					3 7/16	3.4375	96
3¾	4	3.4252	3.5064	3.4794	3 ½	3.5000	77
					0.0453	0.0453	91
					0.0469	0.0469	81
0	80	0.0438	0.0514	0.0465	0.0492	0.0492	67
					0.0512	0.0512	54
					0.0550	0.0550	100
					0.0571	0.0571	88
					0.0591	0.0591	77
1	72	0.0550	0.0634	0.0580	0.0610	0.0610	67
					0.0625	0.0625	58
					0.0630	0.0630	55
					0.0670	0.0670	94
2	64	0.0657	0.0746	0.0691	0.0700	0.0700	79
					0.0730	0.0730	64
					0.0760	0.0760	99
					0.0781	0.0781	90
3	56	0.0758	0.0856	0.0797	0.0810	0.0810	78
					0.0827	0.0827	70
					0.0860	0.0860	56
					0.0860	0.0860	96
					0.0890	0.0890	85
4	48	0.0849	0.0960	0.0894	0.0906	0.0960	79
					0.0937	0.0937	68
					0.0960	0.0960	59
					0.0960	0.0960	98
					0.0995	0.0995	86
					0.1024	0.1024	77
5	44	0.0955	0.1068	0.1004	0.1040	0.1040	71
					0.1065	0.1065	63
					0.1094	0.1094	53
					0.1065	0.1065	97
					0.1094	0.1094	88
6	40	0.1055	0.1179	0.1109	0.1130	0.1130	77
					0.1160	0.1160	68
					0.1200	0.1200	55

EVERY TOOL STEEL HAS AN ALTERNATE

..it pays to know them

AS war production rises rapidly toward its peak, the problem of *materials* becomes more and more insistent.

High Speed Steels furnish one of the best examples, because these special steels depend for their properties on some of the most critical alloying elements in the list. Continuity of supply of High Speed Steel is absolutely essential to continuity of production; yet, under the exigencies of equable distribution, you may encounter a temporary shortness of supply in your first-choice cutting steels at any given time.

It would be wise to protect yourself against such an eventuality. Take precautions against a loss of production time and volume by learning the *alternate* tool steels for your jobs. Get familiar with them —just what they'll do and how they're handled. Frequently the alternate can step into the job with no loss of performance; in a great many cases, a steel can be found that will out-perform the original.

● But play safe—know the alternate tool steels for the types you customarily use. Our Engineering Staff is at your service.

Allegheny Ludlum
STEEL CORPORATION
GENERAL OFFICES: PITTSBURGH, PENNSYLVANIA

Time to Go to War

IF YOU HAVEN'T said it yourself, you've heard other people say glibly, "What we need is a first-class bombing to wake us up."

That's a harsh way of saying that we don't know yet how seriously involved we are in war and that seemingly nothing will arouse us except an extraordinary jolt.

It isn't hard for one to get such an impression, even today, nine months after Pearl Harbor.

At a time when Russia is being hard pressed to keep from being completely routed in the Caucasus, when the Japanese are still in possession of most of their Far Eastern conquests and are edging ever nearer us in the Aleutians, when the British are holding onto Egypt and their position in the Middle East by the skin of their teeth, when a grim military outlook faces us in whatever direction we may turn, what do we see at home?

A postponement of necessarily stringent war measures until after the election, because the administration and Congress want votes in November and believe that application of such measures now will bring down upon them the wrath of the people.

Precious time of the government being devoted to an intra-party fight over nomination of the next Democratic governor of New York and control of the New York delegation to the 1944 Democratic convention.

Important war plants closed down by picket lines growing out of a local jurisdictional battle between the AFL and CIO over which organization should have control of grocery clerks in the city of Pontiac, Mich.

James Petrillo, in Caesar-like fashion from his suite in the Waldorf-Astoria in New York City, telling the broadcasting networks what they can and cannot do and banning from the air a nationally famous high school orchestra.

The farm bloc, regardless of the national welfare, pushing relentlessly for parity or above-parity prices and trying selfishly to take out of the hands of the War Production Board the synthetic rubber program so far as the use of farm products are concerned.

On the surface at least, it appears to be a policy of every man for himself. It is not an inspiring sight. It shows the ugly side of our democracy. It reminds one of the pulling and tugging that went on in France before her freedom was snuffed out.

But let's not give up hope. The very fact that these evidences of selfish interests are becoming repulsive to us as a nation shows that the war spirit is taking hold.

We are becoming strongly alive to the realization that our country must come first. We must think in terms entirely different from peacetime in order to win this war.

What gain is there if labor today wins a point at the expense of the people and in so doing contributes to the loss of its own freedom through defeat? What gain is there in this dark hour if management and labor stand off and eye each other suspiciously rather than work together in a common cause? That's why so much hope is aroused by talks now quietly going on between the leaders on both sides.

What gain is there if you and I cling to our pleasures today if tomorrow the result will be the triumph of Naziism? Better tighten our belts now and go to it with the determination that nothing short of a clean-cut victory can be satisfactory.

Have we the real stuff or are we softies, ready to quit the first time we get a hard sock in the jaw?

Of course we've got the real stuff. But merely saying so doesn't do any good. We must prove it. It's time now for all the people to go to war.

Burnham Finney

GAGING BUSINESS

August machine tool production drops because of material shortages as efforts are made to get higher priority ratings. Ten million tons of new cargo ships planned in next year

Shortage of materials, principally steel, is responsible for a considerable decline in machine tool production this month. It is not possible to forecast accurately how much the drop will be, but it may amount to as much as 15 percent.

This is the first sizable decrease in output since machine tool operations began to soar at the start of the war in Europe. It is expected to be temporary. Washington officials now are at work to relieve the shortage which extends to bearings, motors and other parts as well as to steel.

Ordinarily machine tool builders are not large buyers of steel. Many of them depend upon steel warehouses for their stock. War has not changed that practice. It so happens that a number of warehouses are pretty well cleaned out at the moment, but should be replenished before the end of August or by early September.

The crisis in materials has come about by a loss in priority standing by machine tool builders. Only about half the orders now on their books carry a rating of AA1, AA2, AA3 or AA4. All the rest are in the category of A-1-a or lower. Today it is extremely difficult for a manufacturer with an A-1-a rating to get materials because his claim is superceded by all the companies with AA ratings.

May Get Higher Ratings—The machine tool industry is attempting to secure higher materials ratings for orders now in the A-1-a class, and in this effort it may be successful. One of the difficulties has been that military and naval officials and other war authorities think largely in terms of end products, such as guns and planes and tanks, sometimes overlooking the fact that it takes machine tools to produce war weapons.

Some confusion has arisen because certain war contractors have attempted to apply the new system of materials ratings—AA1, AA2, etc.—to machine tools which they have on order. Machine tool deliveries are not governed by these materials ratings. They are still determined by order E-1-b which involves the urgency rating for each machine tool and the delivery date controlled by a master preference list of war contractors. The master preference list, periodically changed as shifts in the war situation make necessary shifts in emphasis on various war products, is now being revised. The new list should be ready early in September or sooner.

It is probable that the present method of determining the allocation of machine tools will be tied in more closely with the materials ratings of AA1, AA2, AA3 and AA4. The idea is that there necessarily must be a close relationship between deliveries of machine tools and of materials to be machined unless valuable production time is to be lost.

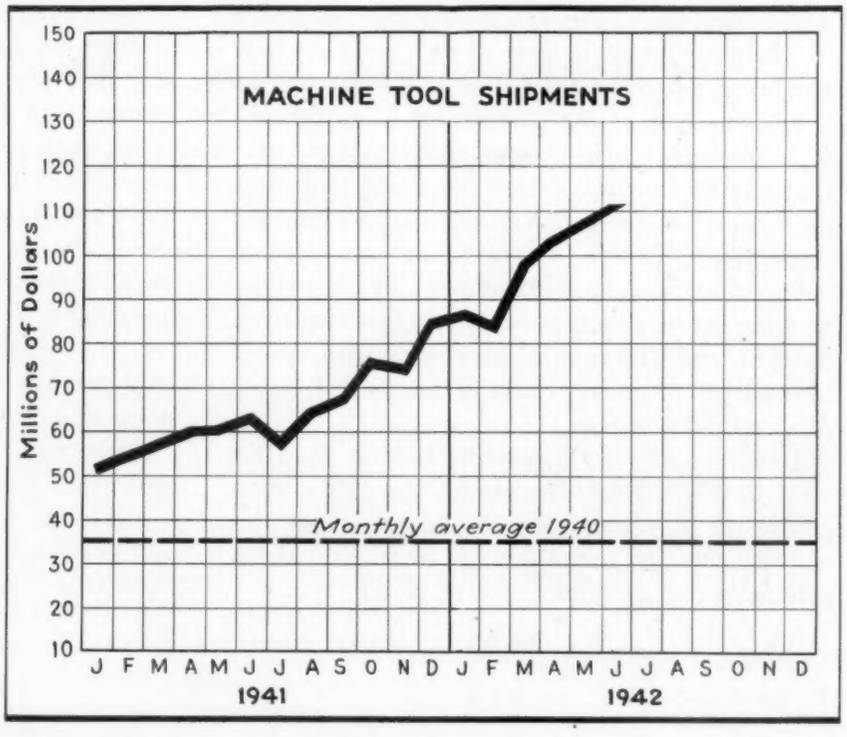
The setback to machine tool operations by reason of materials shortages is likely to result in the industry's going along at a higher rate of output for a longer time than had been anticipated. The latest developments do not alter the conviction, however, that a lowering of the machine tool demand is looked for by many builders early in 1943, despite the fact that some Washington officials hold opinions to the contrary.

Back-Up in Munitions—Production of certain kinds of munitions has progressed to the point where it cannot be transported to the battlefront as fast as it comes off the lines at the factories. Where such congestion has appeared, as in the southern Michigan area, factories are being shut down or curtailed and available materials allocated to plants which are not so far along. This practice will serve to bring production of all war items into better balance.

To take care of the ever-growing flow of war goods until all the weapons can be sent to the battle fronts, a nation-wide network of storage facilities is being developed. The warehouse space of railroads and storage companies will be increased shortly by 11 temporary war-aid depots and by enlargement of existing depots.

The Ordnance Department of the Army is now engaged in an important program of decentralizing its activities so that they will be carried on as much as possible outside Washington. One bit of evidence is the removal of the major part of the small arms ammunition branch to the Frankford, Pa., arsenal and of the motor transport branch to Detroit.

Shipbuilding Plans—Based on appropriation requests by the War Shipping Administration, and the Maritime Commission, 1,031 new cargo vessels will go into operation in the next year. This should total 10 million tons. Production rate is now increasing at a rate of 100,000 tons monthly; for the last quarter was 3,000,000 tons.



Another Production Peak—Continuing a steady increase, machine tool shipments in June were valued at $111,147,000. This amounted to 26,600 units as compared with 25,700 units, valued at $107,300,000, for the month of May

Fabricated Parts Shortage Delays Armament Program

Rise in production comes to halt as some plants have to shut down. Shortages in semi-fabricated parts are cause of trouble. Retrenching based on anticipated shortages

BY ROBERT COLBORN

WASHINGTON—Armament production is in trouble. The skyrocketing is in output levels which nearly doubled production rates in major war items between Pearl Harbor and June, has come to a halt. July production figures failed to top the June levels significantly; in some items production dropped. We're at a plateau, and it will be several months before production rates begin to zoom again.

From all over the country come reports of critical arms plants being shut down or put on short shifts.

Raw Materials Are Blamed

The public is being told that raw materials shortage is causing the trouble. If it were true this would be bad news indeed. There isn't much that can be done about a real materials shortage. Increasing the output of a basic raw material like copper or steel even by a few percent is a year's-long heartbreaking job.

Sometime next year, when war production hits a seven-eight billion dollar a month level, we'll be up against a real materials shortage. And when that happens arms output will have reached its peak. But it would be pretty tough if we'd produced a materials shortage with our present four-five billion program which represents about half ultimate capacity.

Actually, it isn't that bad. What we seem to be up against now is not a shortage of basic materials but a shortage of parts and semifabricated goods—forgings, castings, extrusions, tubing, plates, in some cases things like instruments and subassemblies. Shortages like this are correctible. We only need to provide more semifabrication capacity. And the history of the past few months has proven that we can provide fabricating capacity in a hurry when we have too.

Some shortages are artificially created. The problem of excess inventories has not yet been licked. There are shipyards right now which have a five-year inventory of copper and are still getting deliveries. Few arms plants operate yet on the hand-to-mouth inventories necessary if the most good is to be got out of available supplies. Army and Navy are still among the worst offenders.

Also, there is still considerable slack to be taken up in civilian consumption of materials. Manufacture of durable consumer goods is now on a starvation basis, though the fact is disguised by big inventories. But deep cuts are still to come in production of farm and industrial equipment. Moreover, we can't continue much longer to regard as sacred repair on nonessential equipment.

The impressiveness of these relative and temporary shortages is accentuated by the coincidence that priority rating values are now undergoing an inflation comparable to that of the post-war German mark. The man who finds that an AA-1 rating won't get him fabricated copper finds it easy to believe—as is being said in Detroit—that there'll never be a manpower shortage because the material shortage will catch up with us first.

Part of the present scaling down does arise from absolute shortages. But these are future shortages. Construction of the Higgins shipyard wasn't halted primarily because we lack steel now. The difficulty is that next year, when we're operating a 7 billion program there won't be steel to keep the Higgins yard running. This is the reasoning that produced the decision last May to call a halt on further plant expansion. The same reasoning is producing present contract cancellations.

What's happening is that the chickens of inadequate procurement planning are coming home to roost. Contract letting and plant construction has been concentrated on the big end-product assembly plants to the neglect of the subcontractors, the parts suppliers, the sub-assembly makers. Now, inadequate capacity at these levels is making it impossible to keep the war-goods plants running full time.

Knudsen, Nelson, the former Production Division of OPM and WPB, and the Army buyers failed to realize that each big arms assembly plant is simply the apex of a pyramid of sub-suppliers and fabricators with the mines and ingot producers at the base. The base can't be expanded much, and next year it will set the limits on capacity. But the present trouble is in the areas midway between the base and the apex.

So far, most contract-letting and plant-building has been handled on the basis that if the end-product capacity were taken care of, the normal processes of business would provide the underlying capacity. It hasn't. Not fast enough anyway.

THE TAPE IS RED

NEW YORK—Complaints about the volume of paper work required of industry by the WPB have led to the formation of a Committee for the Review of Data Requests from Industry. Chairman of this WPB committee is Joseph I. Lubin. Trade associations are urging their members to send suggestions on simplification to the Committee in Washington. A report on the results of the study is expected September 30. Meantime industry is literally being asked to fill out a questionnaire to end all questionnaires—or at least reduce their number.

Model Change: War Edition—This dramatic photograph was taken as the last Chrysler M-3 tank came off the assembly line. The changeover to the M-4 was accomplished with no stop in production. The M-3 order was completed 200 percent ahead of schedule. The arsenal expects to set a production record for a new model this month and to increase the schedule after that

Army-Navy Production Award Replaces Three Former Awards; Presented to 77 Plants

WASHINGTON—Seventy-seven plants have received the new Army-Navy Production Award since it was established last month. This award represents a combination of the previously separate Navy "E," Army "A" and Army-Navy Star awards. All employees of firms selected to fly the award receive special Army-Navy "E" pins.

The new award is a burgee bearing a white "E" in a yellow wreath of oak and laurel leaves on a vertically divided blue and red background. "Army" appears in white on the red field and "Navy" appears on the blue field.

The Navy Board for Production Awards, under authority of James V. Forrestal, Under Secretary of the Navy, includes: Admiral H. A. Wiley, Rear Admiral George H. Rock, Rear Admiral W. T. Cluverius, and Captain Frank Loftin. All are retired officers.

The Army Board for Production Awards, appointed by Robert Patterson, Under Secretary of War, includes: Lieutenant General William S. Knudson, Director of Production, Chairman, Major General Charles M. Wesson, Brigadier General Bennet E. Meyers, Edward F. McGrady, A. R. Glancy, and J. E. Harrell.

Many Plants Deserving

Among the plants receiving the award are many machine tool and other metal-working plants:

Abrasive Machine Tool Co., Albert & J. M. Anderson Mfg. Co., American Locomotive Co., Automatic Machine Products Co., Axelson Mfg. Co.

W. F. & John Barnes Co., Bell Aircraft Co., Bendix Aviation Co., Boeing Airplane Co., Borg-Warner Corp., Bryant Chucking Grinder Co., Builders Iron Foundry, Bullard Co., Byron Jackson Co.

Chrysler Corp. (Detroit Tank Arsenal), Cone Automatic Machine Co., Continental Motors Corp., Crawford-Austin Manufacturing Co., Curtiss-Wright Corp. (Airplane Division, Plants 1 & 2).

E. I. DuPont de Nemours Co. (Indiana Ordnance Works), Erie City Iron Works, Federal Shipbuilding & Drydock Co., Fellows Gear Shaper Co.

Gilbert & Barker Mfg. Co., Gisholt Machine Co., Gleason Works, Greenfield Tap & Die Corp., R. Hoe & Co., Humble Oil & Refining Co., Iowa Transmission Co.

Jones & Lamson Machine Co., Kelsey-Hayes Wheel Co., Landis Tool Co., Levingston Shipbuilding Co., McCord Radiator & Mfg. Co., Minneapolis-Honeywell Regulator Co.

National Zinc Co., Navy Yard (Portsmouth), Norris Stamping & Mfg. Co., Ohio Locomotive Crane Co., Picker X-Ray Corp., H. K. Porter & Co., Pratt & Whitney Div. Niles-Bement-Pond Co.

Regina Corp., Remington Arms Co. (Lake City Ordnance Plant), Savage Arms Co., Scovill Mfg. Co., Simmons Machine Tool Corp., Skinner Engine Co., A. O. Smith Co., Stickle Steam Specialties Co.

United Aircraft Corp. (Hamilton Standard Propeller Div.), Western Electric Co., White Motor Co., Whittington Pump & Eng. Co., Wright Aeronautical Corp. Div. of Curtiss-Wright Corp. (Cincinnati and Paterson plants).

Winsome Reminder—Workers on the night shifts at Allis-Chalmers are finding these posters helpful in reminding neighbors and children that they are trying to sleep

Shortage in 138 Groups Is Expected by September

WASHINGTON—Labor shortages are expected to develop by September in 138 of 491 selected skilled and semi-skilled occupations essential to war industries, according to a report by the Federal Security Agency.

Based on a study of registrants available at United States Employment Service offices and anticipated hiring programs, over half of all shortage occupations are found in the metal machining and assembly groups. Only in two occupations are estimated lay-offs expected to supply enough qualified workers to prevent shortages that would otherwise develop.

These estimates are based on national totals and take no account of local shortages and surpluses. Clearance efforts are continually being made to shift workers geographically.

CAMPBELL CITES M-3 ACTION

DETROIT—Presenting the Army-Navy Production Award to the Chrysler Tank Arsenal, Major General Levin H. Campbell, Chief of Ordnance, said that contrary to recent criticisms the M-3 has been superior to anything the enemy has had in action. The 75-mm. high-velocity cannon on the M-3 outranged the 75-mm. Howitzer on the standard German Mark IV by more than 700 yards. "An example of the type of reports received on M-3 performance," General Campbell said, "is one action in Libya wherein eight M-3's, manned by British crews, routed 50 German Mark IV's and destroyed 14 of them." He told the workers that the new M-4's are already at the fronts.

Plan to Double Present Cargo Plane Construction

WASHINGTON—A report submitted by the WPB Committee on Cargo Planes advises that the nation's existing cargo plane program be at least doubled and urges development of longer range land and sea planes.

Present plane program calls for 185,000 planes in 1942 and 1943. It is not revealed just what percentage of this program has been devoted to cargo planes. Commenting on the report, Donald Nelson said, "If we now undertake to build a substantially larger number of cargo planes than is already provided for in our schedule, we must of course cut down the number of some other kind of airplane in our program."

The committee suggests that there be both an increase in cargo plane procurement and also by conversion of certain bombers to cargo type. It also advises a large increase in facilities for the manufacture and transportation of aviation gasoline to meet the requirements of a greatly expanded movement of air cargo. If planes were available, 50 percent of Army and Navy shipments overseas could be carried by cargo plane, it said.

This report, and WPB action in giving a letter of intent for 500 cargo planes of the Mars type to Henry J. Kaiser, met with popular approval. The public had recently made an increasing demand that more attention be given to cargo craft.

Approval of this expanded program was a complete reversal of former WPB policy on the subject, which had been that we could not afford to sacrifice time and materials for it.

Production will now be pushed on types of cargo planes already under construction as well as on the new Martin Mars. Meantime, Kaiser is reported to have his engineers working on plans for a new 200-ton airship.

Fisher Body Tank Arsenal Begins Volume Production

DETROIT—What was rolling farmland six months ago is now the Fisher Body Tank Arsenal. The fixture above weighs as much as a completed M-4 tank. It grips the entire tank hull and revolves it in a complete circle so that workmen can always weld in a downward position no matter what portion of the hull they are working on. In addition to revolving, the fixture tilts sharply lengthwise as required.

The assembly lines on which the all-welded M-4's are turned out is shown at upper right. At right is a battery of boring mills which machine the turret. To help relieve a shortage of these machine tools, Fisher itself built the boring mills required for the arsenal; is now building them for other tank arsenals.

To facilitate milling operations on the hatches and gun ports of turrets, Fisher engineers devised a method, shown below left, whereby two machines can work on one turret simultaneously. The fixture holding the turret is set on a turntable so that another turret can be fixed in position while the first is being milled. The table then revolves and work begins on the second while the first is removed and another is put into position. At lower right is a line of completed tanks awaiting inspection.

Revision in AA Super Priority Ratings Makes No Fundamental Change in Procedure

Blunder made in assigning an AA-2 rating to all previous AA contracts corrected

WASHINGTON — Revision in mid-August of the procedure for the AA super priority ratings makes no fundamental change. What happened was, in essence, that all outstanding AA-2 ratings were converted in one swoop to AA-1, thus avoiding the necessity of individually changing all AA-2s to AA-1s. Then a new rating, AA-2X was created to take the place of the former AA-2.

The reason for this rigamarole was that when the AA ratings were first created a blunder was made in assigning an AA-2 to all contracts which previously carried the old AA emergency rating. These included many of the most important contracts.

WPB Retains Control

At the same time, the WPB informally agreed that the high AA-1 rating would not be applied to any non-military purchases. This has been interpreted as an abdication by WPB of its final authority over materials. This interpretation ignores the fact that AA-1 ratings issued to war contractors still come under the PRP system. A manufacturer holding the high rating may not use it to buy more goods than the quantity assigned him in his PD-25-A form.

Moreover, even under the agreement, WPB is still free to issue the emergency AAA rating to take care of sudden non-military needs—breakdown of an essential public service or the like. Finally, WPB can withdraw from the agreement at any time.

Breakdown of Intention

The agreement arises from the very nature of the AA ratings. Although there has been some breakdown of the original intention, these ratings are supposed to be assigned to a balanced group of strategically essential weapons which can be produced this year and, in the lower AA ratings, to another group which can be produced in the first half of next year.

Actually, all priority ratings are going through such rapid and serious inflation that there's an irresistible tendency to apply the high ratings to nearly everything that looks important.

More Ratings Than Materials

This inflation, it is hoped, will be largely corrected in October when the fourth-quarter PRP ratings start operating. The third quarter was the first in which PRP was compulsory, and—because of intra-WPB dissension and the shortage of time—PRP was pretty badly mishandled in the third quarter. Theory of PRP is that requirements, as revealed by PD-25-A applications will be added up, compared with the total of available materials, and scaled down to match. This was not done in the third quarter. PRP applications were processed in a rather arbitrary rule-of-thumb manner. In consequence, there are more rated orders floating around the country than there are materials.

In the fourth quarter, WPB is determined, rated orders won't exceed materials. The PD-25-A applications all came in Aug. 10. They're being added up now. WPB has until Oct. 1 to match them up. It looks as if this time it might work pretty well.

Hydro-Press Production — At Lockheed Aircraft Corporation parts for the Lightning are formed in this press with a rotary table which can handle more than 20,000 parts in eight hours. Each feeder places one or more small parts on the die as it wheels past him

Stow Company Reports On Small Producer's Plight

WASHINGTON—A small business man pictured his war-boom troubles to the Senate Finance Committee recently when C. F. Hotchkiss, president of the Stow Manufacturing Co. appeared. His company now has the largest volume of business and the highest profits it has ever realized, turning out flexible shafting for the war industries.

The backlog of unfilled orders today is equivalent to 15 years of pre-war business, and it is not unusual for the company to receive in one mail orders representing five years of pre-war production. To make the expansion required large increases in capital were secured from the RFC. This loan is three times the invested capital of the company. Payments on the loan are to be at the rate of 20 percent on sales per month. The firm's profit before taxes amounts to about 20 percent on sales.

Under the new House approved tax bill, the company's taxes will take 87 percent of net income. If the RFC loan is paid new loans will have to be made next March to pay the taxes.

This condition will continue to pyramid until such time as the demand for the product drops off. In this event the firm would have enormous inventories, loans to pay off and a heavy tax liability, with no cash reserve.

After the hearing, Chairman George said the committee would consider some provision to permit a deduction from taxable income for a portion of the payments made on debt by corporate and individual taxpayers.

Service Ceremony —The Pratt & Whitney Division Niles-Bement-Pond Company awarded 95 service buttons to employees who have been with the company 10, 20, 30, 40 and 50 or more years. At left, Nicholas W. Prumbaum receives his 50-year service button from I. F. Holland

July Steel Plate Shipments Reach Record Proportions

WASHINGTON—More than 75 percent of July's record steel plate shipments went to fill Army, Navy and Maritime Commission orders. The remainder was used for export and essential non-military requirements, such as transportation, plant facilities, and machinery.

July plate shipments were 1,124,118 tons compared to 1,050,962 in June. Strip mills shipped 550,537 tons in July as against 489,704 in June. Production of shapes was slightly ahead of June.

INSIDE DETROIT

Warehouse stocks of high-speed steel will be built up by new WPB ruling. Small plants give rush delivery of cutting tools at high prices. Union considers wage demands

BY RUPERT LE GRAND, DETROIT EDITOR

DETROIT—Relief for the cutting tool plant unable to get high-speed steel in the required quantities and sizes may be provided by two moves, one in effect and the other under consideration.

Warehouse stocks of high-speed steels (depleted almost to vanishing point in Detroit warehouses) are to be built up under a directive issued August 1 by the Iron and Steel Branch, WPB. Correspondence states: "Mills are required to supply structural shapes and piling, plates, hot-rolled bars (carbon and alloy), cold-finished bars (carbon and alloy) and pressure and mechanical tubing. These A-products have been most depleted. Mills are instructed to produce a given percentage of these products exclusively for the warehouse trade. All other products upon which orders are placed with the mill by a warehouse prior to August 15 and bearing ratings of A-1-k and duly extended on PD-83-g form are rerated to AA-3."

Return Extra Inventories

Consideration is being given in Detroit to a plan whereby users of high-speed steel would return accumulated inventories to warehouses which would function to distribute the material as required. Some plants have built up inventories of $80,000-$100,000 worth of high-speed steels through a variety of circumstances. First, because warehouse stocks have been depleted, customers have been forced to buy minimum quantities direct from the mill, say three 3-in. bars. Immediate requirements might amount to only a couple of feet from one bar, the remainder being stored pending a new tool order calling for use of that particular size. Or, with steel deliveries running at twelve to sixteen weeks, more than the exact quantity of material for a specified order might be bought, with a view to having material on hand for fabrication of duplicate tools without delay. Some of these purchases were bad guesses because tool re-orders were not forthcoming.

Cutting tool plants would like to unburden themselves of these accumulations if definite assurances are forthcoming that: (1) all inventories will be sent back to the six warehouses in the Detroit area, (2) credit will be given for the material returned and the plant concerned will have the right to draw required material as needed, and (3) guarantees are provided that the mills will keep the warehouse stocks replenished. Local quarters believe that as much as 50 percent of mill material entering the Detroit area would have to be routed to warehouses because in peacetime as much as 70 percent of the business was handled by middlemen. On the other hand, it would probably be necessary to streamline sizes carried, so that the mills would not be required to supply large amounts of material in 1/32 and 1/16 in. variations.

Small Plants Left Out of Pool

The percentage of production that mills are directed to divert to warehouses has not been revealed. It is known, however, that the melting of high speed steel has been cut 25 percent in August, and that shipments in September and October will be adversely affected thereby. Even molybdenum is seemingly getting scarce.

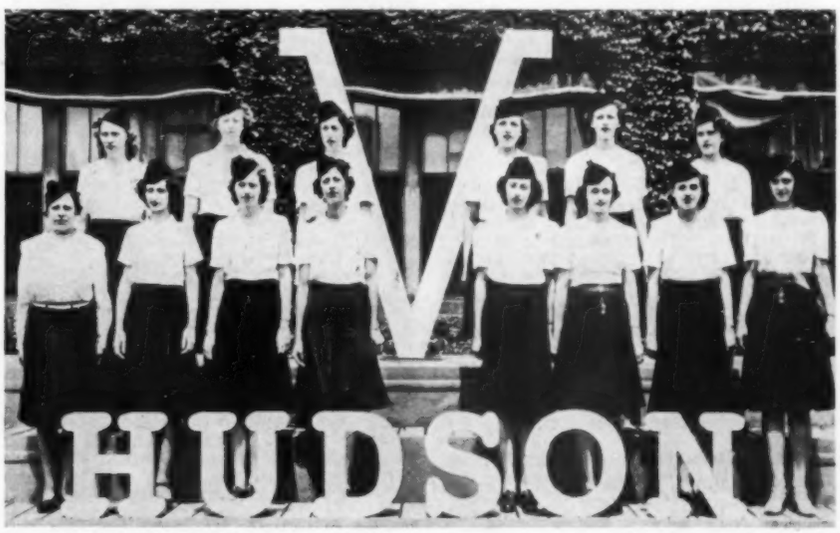
A few months ago, Detroit sources proposed that the small, or alley, tool shops be brought into the pooled production of certain simpler types of cutting tools. Plan was to supply machinery and money to these firms for complete production of some items and the rough machining of others. About $5 million would have been sufficient to finance the program which was viewed as an important means of breaking the tool bottleneck. The plan was turned down on the score that it would put the government in business. As a consequence some 35 small shops have mushroomed according to needs of the moment and are now offering competition to the big plants on even complex items. Quick service on one, two or a dozen tools is provided, at a price. For example, the price quoted by an established manufacturer for a certain item was $27 but with long delivery. A

"WORK TO WIN" IDEAS WORK

DETROIT — Suggestions from Packard war workers, contributed in the "Work to Win" drive, now total 4158. Of the total, 30 percent cover ideas for increasing production. Already 117 have been put in operation and 207 others are being considered for application.

One worker—just a few years out of high school—developed a process that increases the life of a valuable cutting tool 300 percent, at a cost of only 25 cents. Another suggested a change in testing procedure that prevents costly teardowns, saves more than enough to add another engine per month to the schedule. A third designed a time-saving tool that shaves 20 minutes off the production time on one operation.

Full patent protection is given all workers whose ideas prove to be patentable.



Not Behind A Plow—These women who have joined the plant protection force of the Hudson Motor Car Company have been sworn in as civilian auxiliaries to the military police. Army law entitles them to make arrests for violation of any federal regulations. Only one of the girls is less than 5 ft. 10 in. tall

small plant stepped, gave rush delivery at $100 each.

The prices which these rush-order plants are able to get means that they can afford to hire away some of the better mechanics. Profits to owners are likewise large. One partner in a business established nine months ago on a shoe string sold out his interest the other day for $40,000.

On the other hand, wage rates paid by established plants are lower. In a study of several thousand employees, gage makers average $1.90 per hour; boring mill men on jig work, $1.80; grinders, $1.70; tool leaders, $1.85. Average hourly rate for skilled men was $1.63.

The lid has been kept rather effectively on tool and die rates, since the argument over wage stabilization in the tool and die industry and especially equalization of rates in job and captive shops. But rate increases are being pushed through here and there. One method is to call in an employer face to face with a government "conciliator." Another is to call out the men working on critical jobs. For example, if the owner holds out against "a dime for everyone," he may find that his boring mill operators have set up their own "bargaining committee," and quit if their demands are not met.

Wage Conference

John Anderson, president of tool and die Local 155, UAW-CIO, reported to the membership that there is still no decision about a general 15-cent blanket raise demand and other cash increases. A panel of the War Labor Board has had the matter under advisement, and has been meeting with the panels assigned to the General Motors, Ford and Chrysler contract cases before the board. Upshot of the matter is likely to be a tool and die stabilization conference. UAW demands include: (1) 15 cents per hour blanket increase, (2) 15 cent per hour increase in minimum rates, (3) bonus of 20 hours for each three months employment, for employees with less than two years service and 80 hours for one year or more, (4) the union shop, and (5) 10 cents premium for night shift. The Labor Board panel talked in terms of the Little Steel raise of 5½ cents per hour, and was not very sympathetic to the Detroiters' plea on the ground that the local job shop rate is 20 cents higher than the rest of the industry. But the fact remains that the unionists know that the employers are making plenty of money and still have a considerable program to complete although the peak has passed. It is anybody's guess whether a general strike will be called. The tool and die locals are somewhat inclined to go their own way in UAW-CIO matters.

WAR RULINGS IN BRIEF

Checklist of Significant Regulations on Materials and Prices

BLANK BOOKS—The amount of iron and steel that may be fabricated or assembled into metal parts or units for blank books, loose-leaf books, binders or covers has been limited to 30 percent of 1941 consumption. (Limitation Order L-188.)

COPPER—Copper may be used without limit for the manufacture of listed articles when they are ordered by the military services. (Amendment 4, Conservation Order M-9-c.) All deliveries of copper are placed under complete allocation. (Amendment to Preference Order M-9-a.) Foundries and ingot makers must show proof that they are entitled to receive delivery of refined copper, alloy ingots or copper scrap. (Amendment 1, Supplementary Order M-9-b.)

FURNACES—Quotas previously established for the manufacture of furnaces do not apply to replacement parts. (Interpretation 1, Limitation Order L-22.)

HEAT EXCHANGERS—Heat exchangers have been placed under a system of complete allocation. Application for authorization to place orders must be made on Form PD-615. (Limitation Order L-172.)

IRON & STEEL PLATES—Deliveries of iron and steel plates have been restricted to ratings of A-1-k or higher, with certain exceptions. (Amendment to Supplementary Order M-21-c.)

IRON & STEEL SCRAP—Changes have been made in the price schedule for iron and steel scrap to coordinate the operation of the schedule with the allocation of scrap by the War Production Board. (Amendment 7, Revised Price Schedule 4.)

LEAD—Because current lead production is in excess of demand, the monthly lead pool has been revoked. It may be restored at any time when the need arises. (Revocation of Supplementary Order M-38-j.)

MACHINE TOOLS—Issuance of AAA and AA urgency priority ratings has not altered the principles set forth in Interpretation 2 of Preference Order E-1-b. Application of such higher ratings to delivery of machine tools to a Service Purchaser who has an urgency standing does not change date of delivery of the tools. Date of delivery will still be determined by the urgency standing and the required delivery date. (Interpretation 3, Preference Order E-1-b.)

MOLYBDENUM—Molybdenum may be melted only after approval of melting schedules. This action places molybdenum under the same restrictions as vanadium. (Amendment 1, Preference Order M-110.)

RAZORS—Existing limitations on the production of safety razors and razor blades are continued in effect until September 30. (Amendment 2, Limitation order L-72.)

SHIPPING—A priority list of 500 items vital to the nation's wartime economy has been issued by the War Production Board. Only items on this list will be assigned space that becomes available on ships controlled by the War Shipping Administration. In certain cases space not exhausted by items on the emergency list may be used by other items. (General Imports Order M-63.)

TIN—Production and use of wiping solder having a tin content up to 38 percent may be continued until September 1, for all purposes, and until January 1 for installation and repair of lead water service pipe. (Amendment 1, Conservation Order M-43-a.)

TURBO-BLOWERS—No one may place or accept orders for turboblowers unless specific authorization is granted on Form PD-616A. Application should be made on Form PD-616. (Limitation Order L-163.)

TYPEWRITERS—Manufacture will be stopped October 31, except for a small number to be produced by the Woodstock Typewriter Company for Government Agencies. (Conservation Order L-54-a.)

Fostoria Pressed Steel Celebrates Its 25th Year

FOSTORIA, OHIO — The Fostoria Pressed Steel Corporation is celebrating its 25th anniversary this year. The firm was established during the first World War, and now has some 40 distributors.

In a statement by R. J. Carter, president, it was stated that "we are celebrating our 25th anniversary, not with fanfare, but with every effort devoted to doing our full part in the war production effort."

Steel Output Up 23 Percent In Year at Allegheny Ludlum

PITTSBURGH—The dollar value of the Allegheny Ludlum Steel Corporation's July shipments, following a succession of record-breaking months, has again topped all previous records.

Among the special steels included in these record shipments, were Allegheny Ludlum's output of such critically essential materials as aircraft engine valve steels; magnetic steels for plane, tank and gun control equipment; stainless steels for the big bomber program; and high speed tool steels for the general war production lines.

At the July, 1942 rate of increase the company has succeeded in pushing up its output of special steels 23 percent over 1941, in only seven months time. The rate of production is still on the ascent and an even greater margin of increase over 1941 is expected by the end of this year.

WARTIME WASHINGTON

Donald Nelson's position strengthened by WPB changes, but weakened by confused state of priority mechanisms. No possible successor seen. Steel "Black Market" investigated

BY BLAINE STUBBLEFIELD

WASHINGTON—Donald Nelson's position in Washington is today in one sense stronger, and in another sense weaker, than at any time since his appointment. His position in the Washington hierarchy is secure; his job won't be shot out from under him. Two months ago, when officials close to the production figures became aware of the imminence of the production crisis now in the public view (see p. 916c), the War Department's Service of Supply and the Army-Navy Munitions Board made a definite effort to unseat him, to rob WPB of its final control over distribution of materials.

Priorities Confused

In the face of that attack, Nelson went to the President (*AM*—Vol. 86, page 798i) and obtained assurances that the White House is behind him. With that under his belt, Nelson can be confident of keeping his dominant position for a few months at least.

But his position is weakened by the still confused state of the priority mechanism. He has a few months to do it, but in that time he will have to establish a workable orderly machine for getting materials distributed to where they ought to go. And doubts are increasingly expressed in Washington as to whether Nelson will measure up, personally, to the job before him.

No one is disposed to question Nelson's good will. Few question his understanding of the basic problems facing him, but people are wondering more and more whether he has the force, the decisiveness, that the job requires.

Conferences Are Endless

Nothing is ever settled in WPB. Nelson has been unable to discipline his men. Issues in dispute are carried to Nelson, he makes his decision—too often the dispute goes right on. Despite Nelson's announced intention to delegate power to limit himself to saying "Yes" and "No," far too many relatively trivial decisions become enmeshed in endless conferencing and appeals to higher authority. And the one thing Nelson doesn't say, with finality, is "Yes" or "No."

The war program has finished the stage of hit-or-miss plant expansion. Nelson now must demonstrate, and soon, that he can provide the precise and powerful control required to nurse production as close as possible to its theoretical peaks. He hasn't done it yet.

Nelson would be shakier in his job if alternative candidates were in sight. Baruch's name is bandied about, but it's not taken very seriously. Beyond that, there's an amazing lack even of speculation.

Black Market Problems

Congressional testimony by shipbuilder Frank A. Higgins about black market purchases of steel surprised no one who had anything to do with material procurement, but it will unquestionably stir up officials and businessmen who've been inclined to take the black market for granted. There's a simple policing job to be done, but even more important is the necessity to dry up the one big source of hot goods—the still existing inventory stocks. It's estimated that about 18 million tons of finished steel, more than three months' production, is now tied up in inventory.

Industry Concentration

"Concentration of industry" is a phrase that should be in your personal dictionary if it isn't already. It's a method to be used for continuing on a small scale the production of civilian goods which, it's felt, can't be dispensed with altogether. Instead of cutting all regular producers of the item down to a small—and inefficient—percentage of their normal output, most producers are told to quit work altogether while one or two continue to operate at capacity.

The Winner — Forceful, energetic Henry J. Kaiser, West Coast Shipbuilder left Washington after a nine-day whirlwind tour with written authority to build the Mars cargo plane, and a bigger promise to build 200-ton flying boats later on

50,000 PLANTS CONVERTED

WASHINGTON — Approximately 50,000 manufacturing establishments are busy today on producing war materials. Conversions run the gamut from lipstick holders into artillery fuzes to locomotives into cannon. Examples of odd dissimilarities between the peacetime and wartime activities of American industry are to be found throughout the Service of Supply contracts.

A plant's convertability to war production is essentially a matter of equipment and machinery. It is safe to say that 80 percent of ordnance manufacture is by factories which have had to convert their facilities to making new types of products.

English Experiments

This scheme, tried out in England early in the war, has been under discussion here for months; lately it has become accepted as the official approach to the problem. Stove manufacture was concentrated in a few small plants several months ago, and last month a big job of concentration was started in the typewriter industry. After Oct. 31, no typewriter production will be permitted except by Woodstock.

Many other industries are slated for similar treatment. High on the list are porcelain enamel hollow-ware and farm machinery, with many types of industrial equipment close behind.

Trademark Protection

In England, and in early thinking of the subject here, a lot of attention was paid to methods of sharing profits and protecting trademarks and dealer organizations. But as it's worked out in stoves and typewriters no attention has been paid to such niceties. And indications are that other concentration projects will be equally casual. Apparently, big firms in an industry whose production is stopped are confident they are big enough to blast their way back into the market after the war. And anyway, there's a shrewd suspicion that as a result of material scarcities war-time production of civilian goods is going to be so junky that no one will want his trademark on it.

World's Largest Drawing Press Built for Producing Liberty Ship Cowl Ventilators

LOS ANGELES—The largest drawing press in the world has been built at a cost of $50,000 for the Weber Showcase and Fixture Co. Weighing 250 tons, the machine is being used for the production of cowl ventilators for Liberty ships being built in shipyards both on the Pacific and the Atlantic coasts.

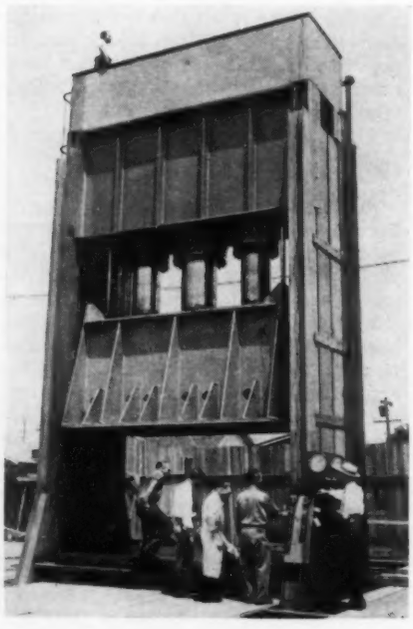
Two punches and dies, of hand ground cast meehanite iron, necessary to form both halves of the largest ventilators, weigh 13 tons. The press uses H-column construction, structural steel taking the place of forgings formerly used as corner posts.

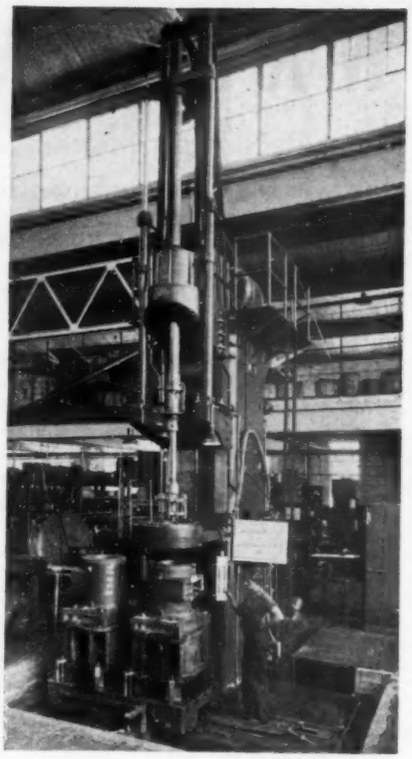
Completed in Ten Weeks

Three hydraulic pumps are employed to move the top platen, two for the downstroke, one for the pullback. Normally the stroke starts down at the rate of five feet a minute, diminishing to three, then two feet, and finally two inches a minute at the end of the thrust. Weight and design combine to give the press strength. The base alone weighs 25 tons, and the top 9 tons. Support is provided by 390 tons of concrete intended both to withstand the force exerted and to dampen vibration.

Three large hydraulic pistons force the top platen down with a force of 1100 tons. Cowl ventilators are made in eight shapes and, with the use of this press, the number of operations is reduced to ten, five involving welding.

Construction of the press was completed ten weeks after plans were drawn. Hydraulic Press and Engineering Co. perfected the plans and handled the construction. Emsco Derrick and Equipment Co. fabricated the base, turned the pistons and welded the top member. The L & F Machine Co. fabricated and welded the movable platen and did considerable lathe and planer work. The Los Angeles Shipbuilding and Drydock Corp. undertook the planer work on the movable platen and the base, bored and ground the pull-back cylinders. Western Pipe & Steel Co. rolled the large cylinders from heavy sheet.





Auto Industry's War Output Nears Double Peacetime Rate

DETROIT—Rapid expansion of operations in old and new manufacturing facilities of the automobile industry is expected to reach a rate of production this year that will double that achieved in the highest year of automobile production, it is reported by the Automobile Manufacturers Association.

Already, the 24th annual edition of *Automobile Facts and Figures* points out, the annual rate of war production equals the best previous year of normal automotive output.

How fully employees of war plants depend upon the automobile for their transportation to work is shown in study which reveals that 57 percent of car mileage, in the nation as a whole, is for necessity uses. It is found, the book reports, that 54,000 communities —or 43 percent of all those in the United States—depend entirely upon motor vehicles for both passenger and freight transportation.

"Invasion Taxi" Produced In Volume By Auto Builder

DETROIT—First completely new tool of warfare to make its bow in the present war, an amphibian tractor is being produced by a former motor car builder. The volume of production is a military secret.

Dubbed an "Invasion Taxi" by the Marines, it is constructed to be carried aboard ship, launched overside by sling and boom and to carry a well-armed and well-armored load of marines through the surf and across the beach.

First tested in 1940, an improved model is now being built. While weeks were consumed in devising special fixtures to hold the large-size steel plates, once the tooling was accomplished the rest of the job was comparatively easy, for the welding that followed called for techniques similar to those used in automobile manufacture.

The inventor began work on the Amphibian in 1933 after seeing the damage done by the Florida hurricane of that year.

Giant Cylinder-Honing Machine Built by Cooper-Bessemer Co.

MOUNT VERNON, OHIO—What is believed to be the largest vertical cylinder-honing machine ever constructed has been built by the Cooper-Bessemer Corporation. It will hone a cylinder with a bore as large as 26 inches.

The firm had found it almost impossible to maintain the tolerances on the bore of the cylinders by boring, particularly on two-cycle power cylinders with ports because on these cylinders the cut is intermittent. Similar difficulties were encountered with grinding the large cylinder bores because of the overhang of the grinding wheel on the spindle.

The new honing machine will handle cylinders six feet long. The machine is equipped with an electrical control.

Total June Employment More Than 56 Million

NEW YORK—Total civilian and military employment rose to the unprecedented total of 56,400,000 in June, as students free for the vacation months and other new workers were drawn into industry and agriculture, according to the Division of Industrial Economics of The Conference Board.

About 1,100,000 workers are estimated to have been added during the month including 150,000 in manufacturing industries and 400,000 in the service industries and the armed forces, the report said.

Assistant Chiefs of WPB Tools Section

Albert M. Stedfast (left) and Benjamin H. Bickle are now serving as assistant chiefs of the Tools Section of the War Production Board. Both have been with the Tools Section for some time

Military Aircraft Builders Have a Good Safety Record

CHICAGO — Manufacturers building military aircraft for the destruction of enemy lives and property were particularly effective in protecting from accidental death or injury the workers who built the death-dealing machines.

Of 31 industries studied, the aeronautics industry was among the top five for 1941 in terms of both accident frequency and severity, according to the National Safety Council.

Workers in the aeronautics industry suffered only 7.40 disabling injuries per 1,000,000 man-hours, as compared with an average of 15.39 for all 31 industries.

The severity of accidents in the aeronautics industry was 0.30 days lost per 1,000 man-hours, as compared with an average of 1.53 for all 31 industries. Tobacco, cement, steel and glass, in that order, had better frequency rates than the aeronautic industry.

NAMES in the NEWS

G. P. Longabaugh has been appointed to coordinate and direct manufacturing engineering activities in the Westinghouse Electric & Manufacturing Company's subcontracting program. The firm is now subcontracting war work at the rate of more than $100 million a year.

W. N. Wood has been appointed plant manager of the American Propeller Corporation, Toledo, Ohio. He succeeds Wayne Eddy, who has resigned. Mr. Wood was previously Factory Manager of the Propeller Division of the Curtiss-Wright Corporation.

W. R. King has been placed in charge of all activities in connection with the promotion and sale of motors, controls, and other electric apparatus to the machine tool industry, for the General Electric Company.

Ralph C. Stuart has been appointed manager of manufacturing to supervise production at five plants of the Lamp Division of the Westinghouse Electric and Manufacturing Company, Bloomfield, N. J.

Frank M. Boylan has joined the Buda Company, Harvey, Ill., in the Idustrial Division.

Clarence E. Stevens has been elected vice president in charge of plant operations for the Norma-Hoffmann Bearing Corporation, Stamford, Conn.

Robert H. Morse, Jr., was recently made assistant sales manager of Fairbanks, Morse & Company, Chicago, Ill. John Elmburg replaces Mr. Morse as manager of the Boston Branch.

R. J. Hearn has been appointed assistant manager of the Boston District Office of the Crocker-Wheeler Electric Manufacturing Company.

F. W. Ochsenhirt, Jr. has been appointed general purchasing agent for the Jones & Laughlin Steel Corporation and subsidiary companies.

After serving in Washington a little more than two years as a staff officer in the offices of the Assistant and Under Secretaries of the Navy, Commander R. E. W. Harrison has been released from active duty to devote his efforts to the provision of the basic tools required for airplane production.

Subcontractor

G. P. LONGABAUGH

Plant Manager

W. N. WOOD

Heads Motor Sales

W. R. KING

Quits Active Duty

R. E. W. HARRISON

Fast Fighter—North American Aviation's Mustang, according to reports from the RAF, is being found useful for low-altitude fighting, for attacks on ground targets, and can carry bombs under its wings like the Hurricane

OBITUARIES

John G. Benedict, 70, president of the Landis Machine Company, died in Waynesboro on August 4, after an illness of two years. Mr. Benedict was also president of the Canadian Landis Machine Company, president of the First National Bank & Trust Company of Waynesboro, vice president of the

JOHN G. BENEDICT

Waynesboro Hospital, and former vice president of the Frick Company. He served for two years as president of the National Metal Trades Association.

Mr. Benedict attended the public schools at Waynesboro and was graduated in 1898 from the State Teachers College, Shippensburg, Pa. He taught school for several years during his college career and for two years following graduation. In 1900 he started as an employee in the office of the Landis Tool Company. Later he became identified with the Fred Frick Clock Company as secretary. He served as Minneapolis branch manager for the Geiser Manufacturing Company until early in 1904 when he returned to Waynesboro as secretary and treasurer of the Landis Machine Company. He played an active part in the development, manufacture, and distribution of the Landis Chaser. He was active in many organizations. He is survived by his wife and two children.

Eugene Bradley Clark, 69, president of the Clark Equipment Company of Buchanan, Mich., and the affiliated Clark Truck-Tractor Company, died recently.

William Peterson, 55, associated with The Kelly Reamer Company for 30 years, and Detroit representative since 1924, died in Detroit recently.

BUSINESS ITEMS

Scully Machinery & Equipment Corporation, Chicago, Ill., has been formed to take over the used and rebuilt foundry equipment business of Scully-Jones & Company. The firm will be located at 2031 W. 74th St., Chicago.

Due to the large amount of special contract engineering work, together with automatic equipment design that the Industrial Oven Engineering Division of The Metal Equipment Company has been doing, a separate organization has been set up to take over this work. It will be known as the Industrial Oven Engineering Company, and will be located at 11621 Detroit Ave., Cleveland, Ohio.

The Strippit Corporation is moving on September 15 to a larger plant at 345 Payne Ave., North Tonawanda, N. Y.

Lobdell Car Wheel Company, Wilmington, Del., has changed its firm name to Lobdell Company.

Linley Brothers Company has appointed Victor Brook, Rochester, N. Y., as representative in Western New York.

The Abrasive Machine Tool Company has completed arrangements for the sale of their grinders in the area formerly served by the Henry Prentice Company. The New England area will be handled from the home office at East Providence, R. I. Firms selected for the remainder of the area are: Russell, Holbrook and Henderson, New York City; C. H. Briggs Machine Tool Co., Syracuse, N. Y.; The George Keller Machinery Co., Buffalo; Motch & Merryweather Machinery Co., Cleveland, whose territory is enlarged; and Swind Machinery Co., Philadelphia, Pa.

The Brown Tool Company has moved from 10465 Carnegie Ave., to 4614 Prospect Ave., Cleveland, Ohio.

Sciaky Bros. have moved into an enlarged building, located at 4915 West 67th St., Chicago.

The Lo-Hed Hoist Division of the American Engineering Company, Philadelphia, has appointed Eiler Equipment Co., 617 N. Washington Ave., Minneapolis, Minn., as representative in that area.

A customs mill for the treatment of carbonate zinc ore with an annual capacity of 48,000 tons will be erected in Nevada. The Defense Plant Corporation has allocated $341,000 for the project. The plant will be operated by Western Metals Company.

Pacific Aviation, Inc., has erected a new factory building at a cost of $250,000.

MEETINGS

National Safety Council. Annual meeting. Stevens Hotel, Chicago, Ill., Oct. 5–9.

National Metal Congress and Exposition. War Production Edition. Cleveland Public Auditorium. Oct. 12–16.

American Welding Society. Annual meeting. Hotel Cleveland, Cleveland, Ohio. Oct. 12–16.

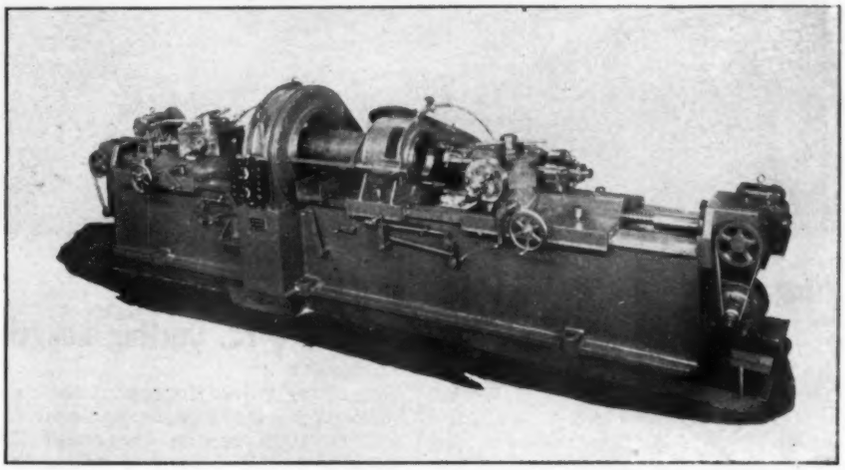
American Society of Tool Engineers. Semi-annual meeting. Kimball Hotel, Springfield, Mass. Oct. 16–17.

Wire Association. Annual meeting. Detroit-Leland Hotel, Detroit, Mich. Oct. 19–23.

National Electrical Manufacturers Assn. Annual meeting. Waldorf-Astoria Hotel, New York, N. Y. Oct. 26–30.

SHOP EQUIPMENT NEWS

Stamets Boring, Facing and Tapping Machine Handles Both Ends of Bomb in One Chucking



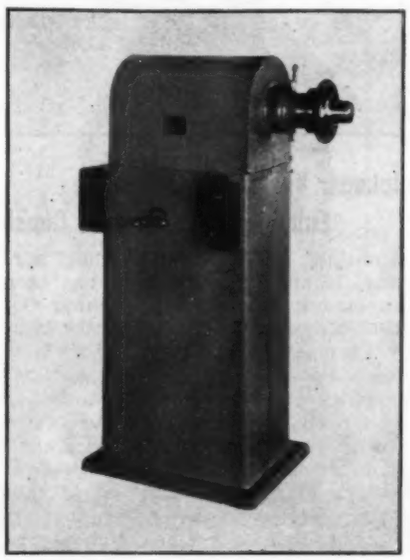
A bomb boring, facing and tapping machine which handles both ends of 100 to 1,000 lb. bombs in one chucking has been announced by William K. Stamets, Pittsburgh, Pa. and is furnished arranged for any one size bomb as specified. The machine consists of a bed supporting a center drive chuck rotating in plain bearings, a rotating center rest which is mounted in anti-friction bearings and a turret carriage on each side of the chuck. Because there is only one axis of rotation concentricity of the finished ends is assured.

The carriages are fed by means of lead screws driven from the chuck and clutched to a motor for rapid traverse. By rotating the nut around the screw by means of a handwheel a handfeed is obtained. The right hand turret carries a boring bar with facing tools at one or two stations and a collapsible tap at another. The left hand turret is equipped with a motor-driven drill unit, a boring bar with facing tools, an undercutting tool when required, and a tap. All tools are supported in guide bushings close to the operation point. The machine has adjustment for possible variation in the bomb length in order to maintain the required overall length.

The bomb is brought to the machine on a conveyor therefore reducing handling time, and is rolled into the machine on a bridge rail and chucked, the closed end of the bomb being forced against a driving ring in the chuck by pressure of the rotating center rest. After the machining of both ends is completed the rotating center rest is rapidly traversed, removing the bomb from the chuck. The bomb is then rolled to the rear of the machine where a tilting fixture drains the cutting oil out of the bomb. During the draining operation the next bomb is chucked and the machining started, after which the completed bomb is sent along on a conveyor at the rear of the machine. Due to locating the tail end of the bomb in the center rest on the fin seat it is believed that the accuracy of alignment is such that no machining on the fin seat diameter is necessary.

Standard Electrical Grinder Has Speed-Change Construction

Announcement of a multi-speed grinder, having not only the speed-change construction but the added advantage of being capable of taking wheel stubs from larger machines formerly discarded, has been made by The Standard Electrical Tool Co., Cincinnati, Ohio. This grinder permits wear of a 12-in. diameter wheel to a 5-in. diameter, maintaining the peripheral speed throughout the life of the wheel. The totally inclosed motor is mounted on an adjustable plate on back of the pedestal and the power is transmitted to the grinding spindle through a multiple V-belt drive. A push button safety starter is located on the front of the machine. The safety guards are hinge door type, each having a work rest, an exhaust outlet and adjustable spark breaker. Overspeeding of grinding wheels is prevented by an interlocking arrangement. Other multi-speed grinders are available for vitrified or high speed wheels up to 30-in. diameter.



Wigglesworth No. 3 Miller Has Auxiliary Power Feed

A No. 3 high speed small parts miller with auxiliary power feed has been introduced by Wigglesworth Machine Tool Co., 195 Bent St., Cambridge, Mass. The table feed is by hand or power. The design of the power longitudinal feed

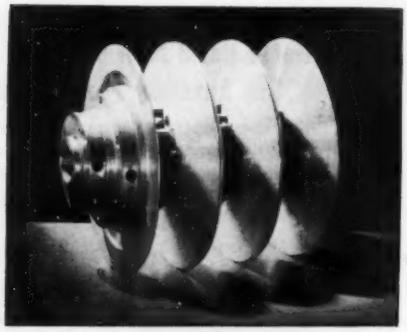
is rugged and powerful, providing the steady smooth feed necessary to give a fine finish without chatter marks. The drive is through a pair of 45 deg. angle spiral gears in the saddle to the worm. This assembly is held in a rocker which throws in and out of mesh with the table rack. The drive to the table feed is taken from a 3-step cone pulley on rear of the spindle to a 3-step pulley on the feed shaft. Proper reduction of the spindle speeds is obtained through the planetary gears to give correct rates of feed to the table. Six rates of feed are obtainable by means of the interchangeable pulleys.

The spindle is hardened and ground

and mounted on two Timken precision roller bearings. The nose is fitted with No. 40 standard milling machine taper. The knee has long dovetail slides for vertical movement, and transverse movement of the saddle. The drive of the machine is by V-belts from the motor in the base through an intermediary shaft to the spindle. The working surface of the table is 7 × 20 in., motor is 1 hp. 1200 r.p.m.

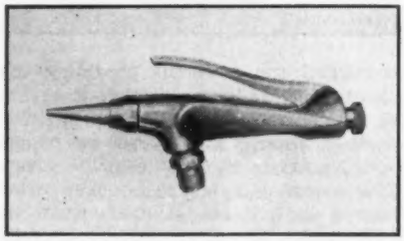
A-C Vari-Pitch Sheave Increases Speed Variations

A wide-range vari-pitch sheave has been developed by Allis-Chalmers Mfg. Co., Milwaukee, Wis. Speed variations from 66 to 116 percent are possible with this sheave. It is used with a companion sheave grooved for new, wide Texrope V-belts. The equipment is made in sizes to fit the shafts of all standard motors from fractional to 30 hp. The companion sheaves are made in sizes to meet requirements of the wide-range applications.



DeVilbiss Type SGF Flow Gun Suited for Caulking, Cementing

The Type SGF flow gun, produced by the DeVilbiss Co., Toledo, Ohio, is suitable for caulking, cementing and other flowing operations where plastic materials, sealing compounds and heavy paints are used. This gun is particularly handy in doping and cementing fabric parts of aircraft as well as for similar production jobs. It is small, lightweight, well-balanced and fits the hand comfortably and operates easily.

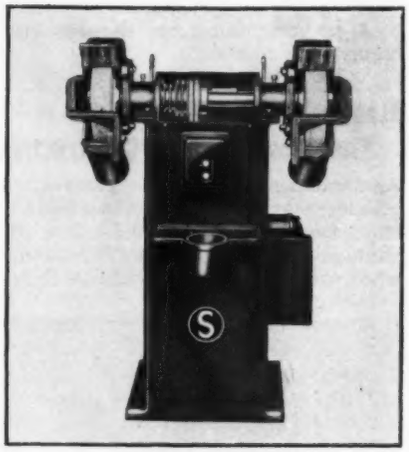


The material is fed to the gun under pressure and extruded into cracks and grooves over seams which are to be sealed. The volume of flow can be controlled by simple knurled nut adjustment of the fluid needle or by regulation of the pressure. Nozzles are available for all materials.

Niagara Series L Power Squaring Shear Gives Full Visibility Over 20 Ft. Cutting Length

The Niagara Machine & Tool Works, Buffalo, N. Y., has added a new long-length power squaring shear to the Series L line. The cutting length of the shear is 20 ft., and by utilizing the gap in the housings even longer sheets may be squared, slit and trimmed.

The large bed and housings together with the triangular section crosshead maintain straightness and correct clearance of the knives throughout the cutting length. Quick gaging and convenient operation speed up the handling of stock, while full visibility of cutting line facilitates cutting to a scribed line. Self-measuring, ball bearing, parallel back gage measures in increments of 1/128 in. The drive mechanism is completely inclosed in an oil-tight case and operates on anti-friction bearings.



Schauer Variable Speed Lathe Equipped With Sjogren Chuck

A variable speed lathe for filing, burring, lapping and polishing has been announced by Schauer Machine Co., 2067 Reading Rd., Cincinnati, Ohio, which handles screw machined parts up to 1⅝ in. in diameter. A Sjogren chuck operates a spring-type collet which may be quickly adjusted to the size of the work by means of a handwheel mounted on the chuck. Motor speeds as low as 20 r.p.m. ranging up to 4,000 r.p.m. are available. Variation in spindle speeds is obtained by movement of a variable pitch pulley which is controlled by a ball crank conveniently located. The motor is spring mounted in the base of the pedestal and automatically controls the belt tension. This motor and the brake control are hand operated.

G. E. Air Circuit Breaker Lessens Power Interruptions

Announcement has been made by the General Electric Co., Schenectady, N. Y. of a Type AG-1 high-speed air circuit breaker which lessens the possibility of power interruptions in plants using direct current for the reduction of vital metal such as aluminum and magnesium, and for various continuous processes. Short circuits are removed in less than one cycle. By interrupting the circuit in less than a cycle the breaker limits the current that can flow into the faulty anode to values of less than 50,000 amperes. This can be accomplished because breaker design utilizes the effect of magnetic loop expansion, working to a double advantage. The increased pressure at the contacts prevents burning of their surfaces where the circuit is normal, but when the breaker is tripped during abnormal conditions the loop expansion effect helps separate the contacts quickly.

A high-speed current directional trip initiates the opening of the contacts.

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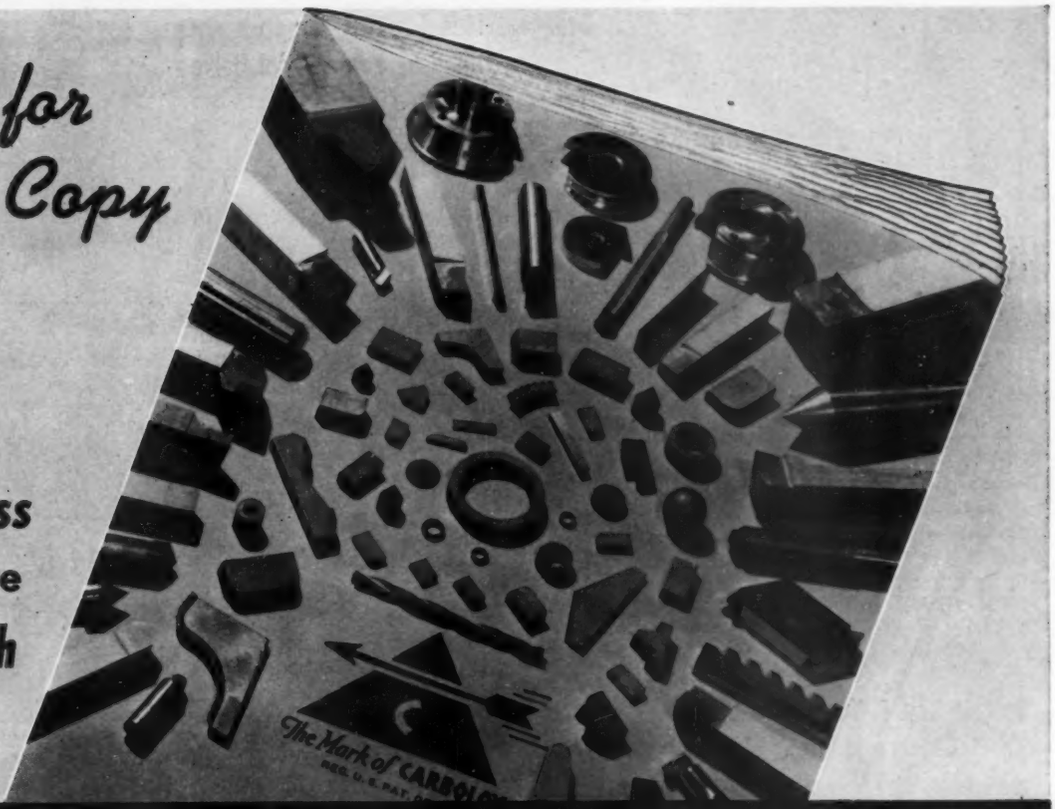


Off the Press on or before August 15th

New, Complete Carboloy Tool and Blank Catalog

We announce the release—on August 15th—of a special catalog, containing—under one cover—a complete listing of specifications and prices of Carboloy standardized tools and blanks available for war production. Designed to provide a quick, ready reference for those selecting tools for war work, this new catalog lists a wide range of products available in stock for prompt deliveries. As a special supplementary feature, the designs of a number of special types of tools commonly used have been standardized. Specifications and prices of these are included—eliminating delays for quotations, blueprints, etc. Also contains suggestions for saving time and money on your made-to-order tool requirements.

Reserve your free copy today, you'll find it to be a handy, time-saving guide.

Important Listings

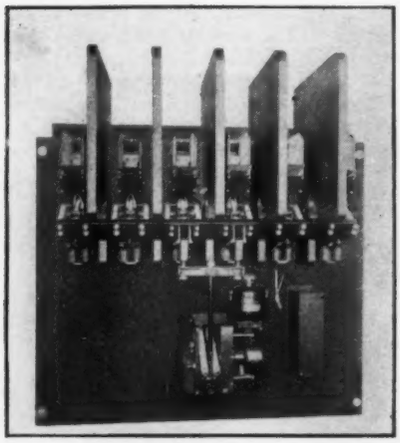
Standard Tools (Incl. new sizes to be stocked)	(Stocked)
Standard Blanks (Incl. new sizes and styles to be stocked)	(Stocked)
Standard Boring Tools	(To be stocked)
Diamond-Impreg. Wheel Dressers	(Stocked)
Diamond-Impreg. Grinding Cones	(Stocked)
Masonry Drills	(Stocked)
Carboloy Guide Rings	(Stocked)
Carboloy Brinell Balls	(Stocked)
Lathe and Grinder Center Tips	(Stocked)
Lathe and Grinder Centers	(Partial Stock)
Twist Drill Blanks	(Standard Design)
Shear Type Tools	(Standard Design)
Cut-Off Tools	(Standard Design)
Grooving Tools	(Standard Design)
Plug and Ring Gage Bushings	(Standard Design)
Drill Jig Bushings	(Standard Design)
Roller Turner Tools	(Standard Design)
Staples-Type Exp. Reamers	(Standard Design)
Solid Reamers	(Standard Design)

Etc., etc.

CARBOLOY COMPANY INC., 11149 E. 8 MILE ST., DETROIT, MICH.
Chicago • Cleveland • Los Angeles • Newark • Philadelphia • Pittsburgh
Canadian Distributor: Canadian General Electric Co., Ltd., Toronto, Canada

CARBOLOY CEMENTED CARBIDES
TOOLS - DIES - DRESSERS
CORE BITS - MASONRY DRILLS
- WEAR RESISTANT PARTS -

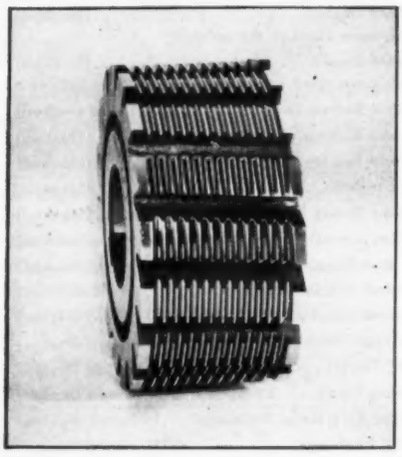
FOR THE MANUFACTURING · MINING · TRANSPORTATION · CONSTRUCTION INDUSTRIES



The breaker has an arc chute of the magnetic blow-out type which multiplies the magnetic effect of the current and rapidly lengthens the arc back to its extinguishing point. The breaker automatically closes the cleared circuit in about a minute.

Detroit Tap & Tool Milling Cutters Made in Three Styles

A buttress-thread milling cutter, which relieves the ends of the threaded portion automatically by removing the feather edge at the end of the thread as it mills the threads, has been announced by the Detroit Tap and Tool Co., 8432 Butler St., Detroit, Mich. The cutter is available in both shell and



shank types for both external and internal milling of threads on such parts as cylinder heads and propeller hubs. With the extremely close tolerances required for such work the threads as well as the plain cutting portions of the cutter are ground from the solid.

Three basic styles are furnished, one for relieving one end of the thread only, another to relieve both ends, or without plain cutting portions. The cutters can be supplied in any style to suit standard thread milling machines and in both spiral or straight gash types.

Crescent Model 'NTTD' Tractor Controlled by Four-Wheel Drive

The Model "NTTD" tractor brought out by the Crescent Truck Co., Lebanon, Pa., features four-wheel, extra large external contracting brakes, mounted on the worm shaft and providing equal braking on all the wheels. It is operated by two heavy-duty tractor drive units, including two motors.

The travel of the unit is controlled by a lever-operated drum type controller which is interlocked automatically with the operator's seat and brake foot pedal. If the controller is left in any speed position, the handle must be brought to neutral with brake released and operator seated before power can be applied. The battery compartment can be furnished for either side or top removal of the battery.

This model gives a drawbar pull of 800 lb. normal, and 3,600 lb. ultimate. The overall length is 84 in., wheelbase 48 in., and height is 59 in.

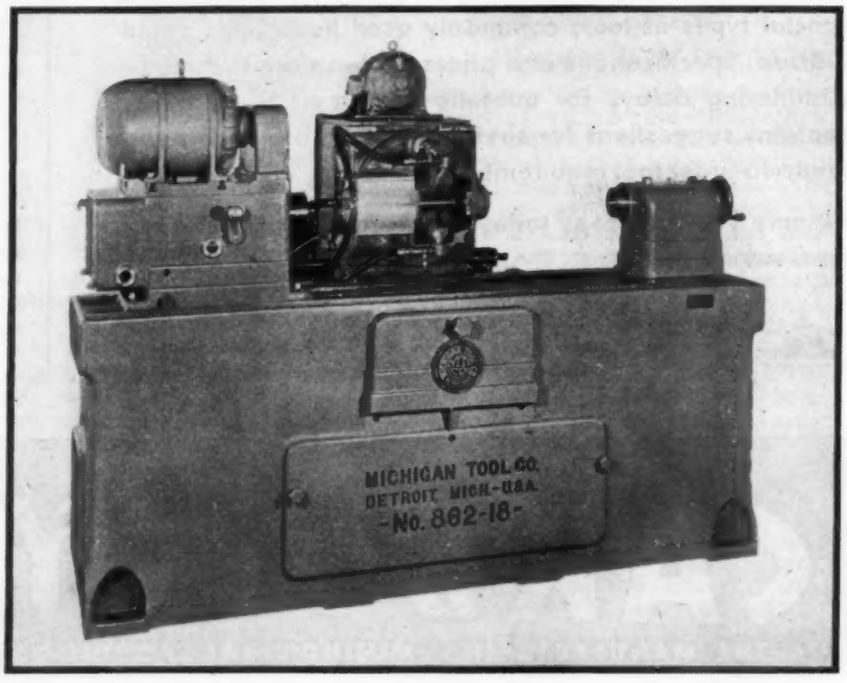
Michigan Tool 862 Series Heavy Duty Gear Finisher Permits Application to Wide Range of Gear Sizes

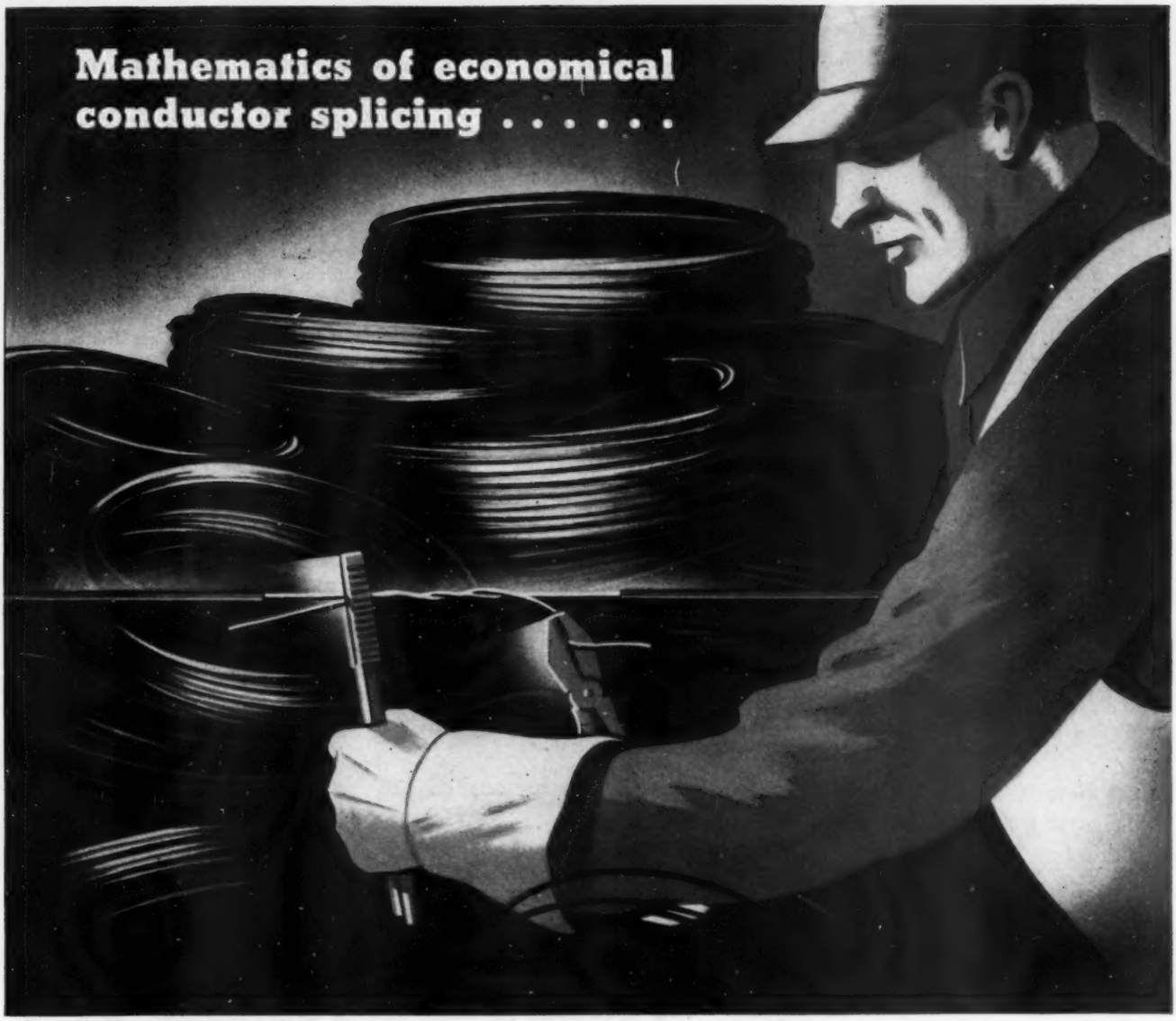
Gears as small as 2¼ in. and up to 24 in. in diameter can be finished with the new 862 series of heavy duty gear finishing machines, available in two sizes, which has been introduced by Michigan Tool Co., 7171 E. McNichols Rd., Detroit, Mich. Face widths up to 20 in. can be accommodated.

Three methods of gear finishing are available on the machine. In the first method, particularly suited to finishing wide face gears, the cutter, in addition to having an infeed toward the gear, is reciprocated parallel to the axis of the gear. This is done by placing the slide which carries the cutter head in a horizontal position. In the second method, used for quick finishing of gears having a narrower face width than the cutter, and also for close shoulder work, the slide is set vertically. The cutter is in the same crossed-axis relationship to the gear as in the first method. The third method is a combination of the first and second. The cutter slide is vertical, but infeed is used, the cutter head reciprocating vertically instead of horizontally. The gear is finished by a number of vertical passes instead of one as in the second method.

Provision to permit crowning of gears when desired is made on the 862 finisher, thus helping to assure more even tooth loading and reduced wear.

Splash guards are supplied on this machine, and a separate motor driven rotary type coolant pump is furnished with lines supplying coolant both above and below the cutter. The base of the machine is fitted with a large reserve tank with screens to prevent the entry of chips into the pump. A plunger pump supplies oil to the infeed gear box in the cutter head while two manually operated reservoir oilers lubricate the cross and infeed slides.





Information supplied by "American Machinist"

With the copper situation what it is, it must be a question in many plants as to when conductors are worth splicing, and when they should be scrapped.

In one case, the minimum lengths of standard wire that can be spliced economically have been carefully calculated for each size and type of wire used.

In fact, the question has been reduced to the following equation: XA = ½B + $0.12 + $0.02 + XC where: X = weight of copper corresponding to minimum spliceable length of given wire that can be economically spliced.

A = constant equal to the price per pound of new wire.

B = constant equal to the hourly labor rate.

C = constant equal to the junk price of copper per pound. $0.12 and $0.02 respectively are the costs of the sleeve and tape required for splicing.

Solving the equation for X gives the weight of the shortest length that can be economically spliced.

CLIMAX FURNISHES AUTHORITATIVE ENGINEERING DATA ON MOLYBDENUM APPLICATIONS.
MOLYBDIC OXIDE—BRIQUETTED OR CANNED • FERROMOLYBDENUM • "CALCIUM MOLYBDATE"

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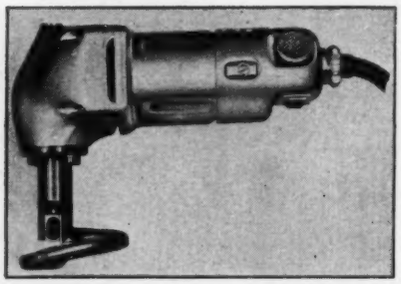
MOLY

Redesigned Lectro-Shear Provides Easier Handling

The Black & Decker Mfg. Co., Towson, Md. has redesigned its 16 and 18 gage Lectro-Shear. The outer dimensions of the No. 18 shear have been reduced so that the motor housing forms a convenient operating handle. Thus the weight and length of the tool have been



reduced and the balance and control improved.

The larger No. 16 shear has been equipped with an improved operating handle for better control on curved and irregular lines. It has an instant-release trigger switch with locking pin for continuous operation. The shape of the handle is suitable for use over the tool or at the rear end.

Weaco Blueprint Machine Will Quickly Dry Prints

The Weaco blueprint dryer introduced by Warren Electric Appliance Co., Warren, Pa., permits the drying of blueprints on the spot and is made to accommodate standard 30-in. paper in lengths up to 32 in. The drum measures 34 × 18 in. in dia. and has a drying

surface of 32 × 52 in. It is claimed that the equipment will dry a blueprint in about five minutes. It uses only 700 watts on 115 volts, either a.c. or d.c. operation. The drying belt is made of tough, preshrunk material.

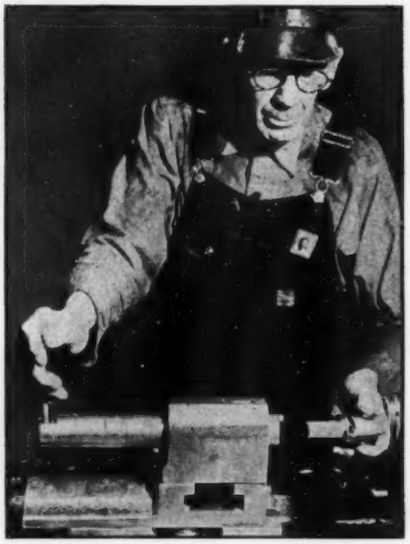
Universal Vise Provides Three Separate Adjustments

Three separate setting motions, individually adjustable and locking, are provided in the precision universal vise announced by Universal Vise & Tool Co., Parma, Mich., for angle drilling, grinding, milling, checking and for any operation on or off a machine tool involving single or compound angles. The double swivel cradles each allow 90 deg. adjustment over 360 deg. rotation of the base. Four bolts lock each cradle, and both cradles and swivel base are graduated.

The vise is fully portable and may be moved from one machine to another without removing the workpiece or disturbing the work angle. Steel vise jaws, hardened and ground, are provided. The jaw opening and width are over 5 in. while the height in horizonal position is only 7¼ in. The weight of this unit is 70 lb.

Tool Changing Time Cut With Lane-Wells Toolholder

A toolholder suitable for attachment to an engine lathe has been announced by Lane-Wells Co., 5610 S. Soto St., Los Angeles, Calif. The device is said to cut tool changing time to about five seconds and to greatly reduce operating time. It consists of a toolpost fitted to the carriage compound rest of a lathe.



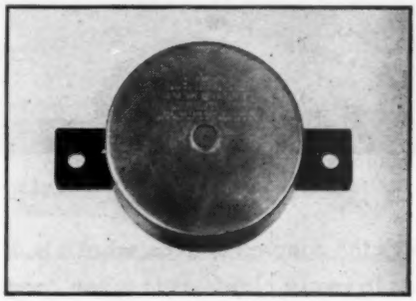
Standard high-speed toolbits used for boring, turning, threading, facing or forming are fastened into the heads and each bit remains in place. Drills and reamers may also be used. In operation the first head is placed in the toolholder and locked in place by a quarter-turn of the control handle. When the operation on the stock is performed by the first tool, the operator releases the head and replaces it with the second head and locks it in place.

If a working operation is interrupted by other work to be done, the toolholder permits the original tool to be reinserted in the toolholder in the same position it originally occupied. The work can then be resumed without the necessity of resetting the position of the holder. The one toolholder will perform either outside turning or boring operations.

G. E. Secondary Protector Gives Open-Circuit Protection

For use on current transformers to provide protection against high open-secondary circuit voltages the General Electric Co., Schenectady, N. Y., has brought out a Thyrite secondary protector which consists of a disk of Thyrite connected across the transformer secondary terminals, together with a thermostatically operated short-circuiting switch.

If the secondary circuit becomes accidentally opened, the secondary current will pass through the disk. When



the temperature of the disk reaches approximately 100 C., the thermostat operates the switch to short circuit the disk and prevent damage that would be caused by overheating. The switch opens when the temperature of the disk drops to about 80 C. This operation is repeated until normal conditions are restored to the secondary circuit, at which time the switch will remain open.

The unit can be used on current transformers which operate meters or relays.

Westinghouse Transformer Improved by Clip Terminals

An improved Type A current balancing auto transformer for differential protection of power transformer banks has been announced by Westinghouse Electric & Mfg. Co., Dept. 7-N-20, E. Pittsburgh, Pa. The unit has been stream-

"SHANGRI-LA"

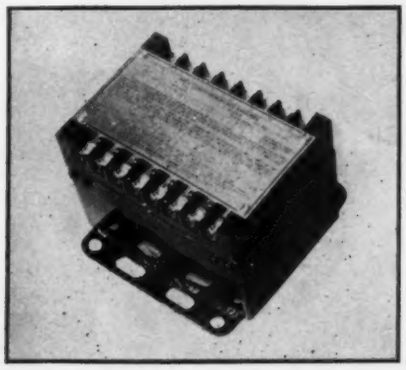
From the assembly lines of America's giant aircraft factories roll the bombers that are blasting the way to Victory. Huge hydraulic presses, capable of exerting pressures up to 5,500 tons, feed a steady supply of parts to the assembly floor. Here is "Shangri-La" in fact.

Scores of hydraulic presses built by Baldwin Southwark have taken their places on aircraft production lines. Many more are at work producing propellers, tires, self-sealing gas tanks, and plastic parts as well as sub-assemblies for other suppliers to the aircraft industry.

Many of the improvements in airplane design have been made possible by Baldwin Southwark physical testing machines and instruments. Every major plane manufacturer in the country uses testing equipment produced by Baldwin, including machines so powerful they pull metal apart, instruments so small they weigh only a small fraction of an ounce.

Information and illustrations on this Southwark equipment are contained in two bulletins available on request. For data on hydraulic presses, No. S-160; on testing machines, S-161.

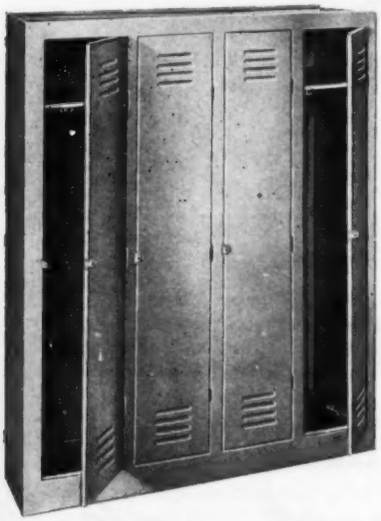
Baldwin Southwark Division, The Baldwin Locomotive Works, Philadelphia; Pacific Coast Representatives, The Pelton Water Wheel Co., San Francisco, California.



lined and clip terminal connections replace the cable leads. These terminals on the terminal block make it possible for connection to be made to the customer's leads without removal of any parts from the transformer. The diagram nameplate is mounted on top of the terminal block and figures on the edges indicate the lead numbers. The mounting plate is arranged for flat surface mounting or pipe frame mounting by means of U-bolts. These transformers are available in ratings of 50 and 100 volt amperes with a nominal ampere ratio of 10.8/5 to 5/5.

Lockercraft Plywood Lockers Built in Folding Hinged Design

Wood lockers in standard and special sizes have been announced by Lockercraft Co., Canton, Ohio. Folding hinged design permits easy shipping and erecting simplicity. Standard sizes are provided in units of four single tier or eight double tier sections. Each section conveniently folds into knocked-down position, and to erect it is nec-



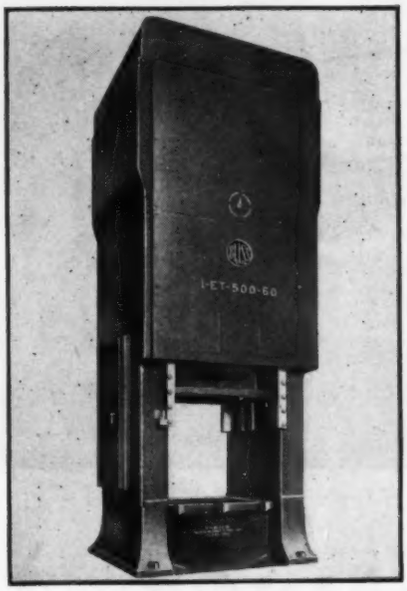
essary only to slide in the top, bottom and shelf panels which lock into place.

Panel construction of the locker is plywood, moisture-resistant treated. The door frame is 1-in. poplar and the doors are ¾ in. plywood with slotted louvers. It is supplied with either keyed locks or hasps for padlocks and with two double coat and hat hooks.

Bliss Double Action Toggle Press Convertible to Triple Action

A line of inclosed one-point double action toggle drawing presses has been announced by the E. W. Bliss Co., 53rd St. & 2nd Ave., Brooklyn, N. Y., which embodies all the latest ideas in the design and construction of double-action, single crank, toggle drawing and deep stamping presses. This number 1-ET-500-60 press is built with practically any pressure capacity stroke or die space that may be required.

The press frame is of the conventional four-piece steel tie rod construction consisting of a base, two uprights and crown held together by four large steel tie rods shrunk into place.



The machine can be converted into a single action unit by disconnecting the toggle mechanism from the blank holder and attaching the outer slide to the inner slide which is operated in the usual manner, thus adapting the press for blanking and forming operations. Easy conversion can also be made to a triple action machine by fitting pressure attachment into the bed of the press. It can also be fitted with synchronized mechanical third motion in the bed for work requiring a machine of this type.

Oil-Rite Wick Type Lubricator Insures Regulated Lubrication

A wick type lubricator has been announced by the Oil-Rite Corp., 3466 S. 13th St., Milwaukee, Wis. It is designed to deliver a positive, constant and regulated amount of filtered oil to the shaft or bearing of loose pulleys, idler pulleys, clutches, eccentrics and similar rotating machine parts. The lubricator consists of a glass oil reservoir mounted on a hollow metal stem. Except for two small ports at the top the stem is sealed from the oil in the reservoir. A felt wick inside the stem extends through

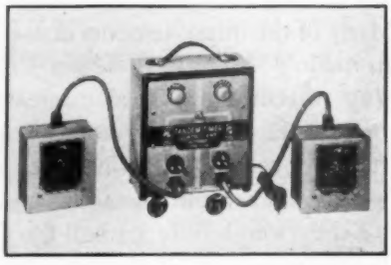
the pulley hub and rests directly on the shaft. A compression spring is wrapped around the wick to hold it firmly in position against the shaft.

As the pulley rotates, and lubricator with it, centrifugal force throws the oil against the top of the reservoir and into the two ports in the stem. Through them the oil is admitted to the wick, which filters out all dirt and sediment, and conducts the oil to the face of the shaft. The amount of oil to be delivered to the shaft or bearing is regulated by means of a small plug which controls the area of the oil ports. Five standard sizes of lubricator are available in capacities from ¼ to 2½ oz., for standard tappings from ⅛–¼ in.

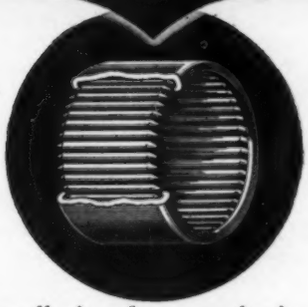
Industrial 'Tandem Timer' Features Automatic Reset

The "Tandem Timer" introduced by the Industrial Timer Corp., 113 Edison Place, Newark, N. J., permits practically any timing sequence desired for life testing of electrical apparatus. It is a control unit with two individual and variable plug-in type timing elements. When the timer dials are once set at the time interval desired, no further adjustment is necessary until a new sequence is required. With the timing elements set to their correct respective time intervals, each cycle of operation will follow the other continuously.

The control cabinet measures



THE "*ROUTINE PART*" IN WAR MATERIEL



INSPECTION keeps a manufacturer "on his metal" these days. Changes come thick and fast in war production. That tank rolling off the assembly line may be a redesign... the last shipment of machine parts may have been supplied by a newcomer to the Victory program.

But there's a routine part in most war materiel—the Torrington Needle Bearing. As new type equipment comes out of production for approval, Chief Inspectors are increasingly aware of the Needle Bearing's presence in the finished assembly. Long since "changed over" to production-for-war, this unusual bearing is meeting every new requirement of industry today.

Its small size, for example, is conserving space and critical materials. Its remarkable ease of installation is cutting assembly time... its simplified design is eliminating extra parts and assembly steps... its low coefficient of friction assuring smooth performance ...high capacity and efficient lubrication reducing the need for replacement or maintenance attention—all vital wartime needs, speeding production.

In its adaptability to the latest type fighting machines, as well as the equipment that assembles them, the Needle Bearing is again demonstrating its unique advantages—and in applications where these advantages mean more today than ever.

***FOR INFORMATION** concerning capacities and sizes, send for Catalog No. 105. Or consult a Torrington engineer. He is an expert in adapting the Needle Bearing's advantages to specific problems.*

THE TORRINGTON COMPANY
TORRINGTON, CONN., U. S. A. • *Est. 1866*
Makers of Needle and Ball Bearings
New York Boston Philadelphia Detroit
Cleveland Seattle Chicago Los Angeles
San Francisco Toronto London, England

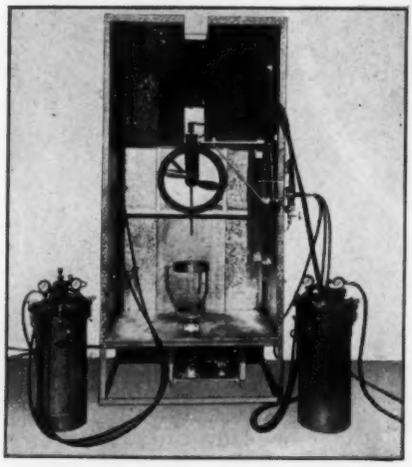
TORRINGTON NEEDLE BEARING

Every feature fills a wartime need

8½ × 8½ × 5 in. and contains a single cycle start push button switch, the on and off toggle switch, repeat and single cycle toggle switch, pilot lamps, receptacles and sockets. The timing elements are synchronous motor driven and are contained in a formed steel box measuring 5 × 5 × 3 in.

Eclipse Air Brush Sprayer Coats 8-in. Shell Vertically

For spray coating 8-in. shells in a vertical position the Eclipse Air Brush Co., 400 Park Ave., Newark, N. J., has brought out a shell sprayer. The inside coating is done with a semi-automatic spray gun fitted with a long extension nozzle. The extension nozzle is lowered into the shell and the spray operates as it is withdrawn. The same operator who handles the inside coating operation can manually spray



the outside of the projectile. The shell is rotated by an air motored tripod with a ring at the top to protect the driving band from paint.

Two separate paint containers, one to hold the outside and the other the inside paint, are part of this unit. The spraying is done in a booth equipped with a bronze-bladed exhaust fan. The shells enter the booth from the top on an overhead conveyor.

Studebaker 'Drilvise' Has Non-Slipping Holding Pressure

The hydraulic "Drilvise" announced by the Studebaker Machine Co., 9 S. Clinton St., Chicago, Ill., is entirely foot-controlled and permits the use of both hands in the operation, set-up and removal of the work from the machine. After the work is placed between the open jaws the operator moves the rear jaw toward the stationary front jaw by depressing with one stroke the middle pedal of the foot control. The right or booster pedal moves the jaw a maximum of $\frac{1}{16}$ in. for each downward stroke of the foot and exerts a maximum non-slipping pressure of 10,000 lb. per sq. in. The left pedal is depressed with one

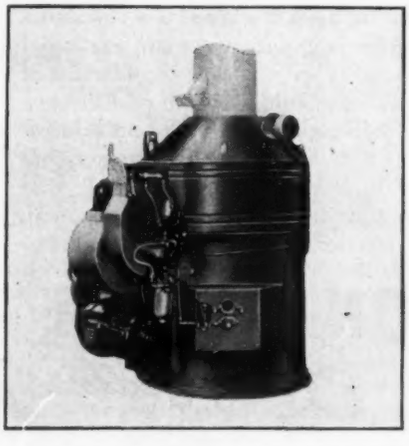
downward movement of the foot to release the work held between the jaws. The tightening and releasing operations are done in a few seconds.

The jaw plates held by two 1¼ in., 20 thread machine screws and plates can be easily removed or replaced with special jaw faces. Cross slots and side ears are provided so that the "Drilvise" can be bolted either across or lengthwise. The tool measures 30 in. long, 8¼ in. wide and 5¼ in. high and weighs 74 lb. The width of the jaw is 6 in., the opening 5 in. and depth of throat is 3 in.

The unit requires no outside power or air supply and consists of a conventionally-shaped drill press vise, without usual screw or handle. The foot control base is connected to it by a 6-ft. length of flexible rubber tubing.

Vapor Steam Generator Unit Meets Minimum Space Needs

Development of a recirculated type steam generating unit which requires no boiler room or high draft stack has been announced by the Vapor Car Heating Co., Inc., Room 1435, 80 E. Jackson Blvd., Chicago, Ill. It is com-

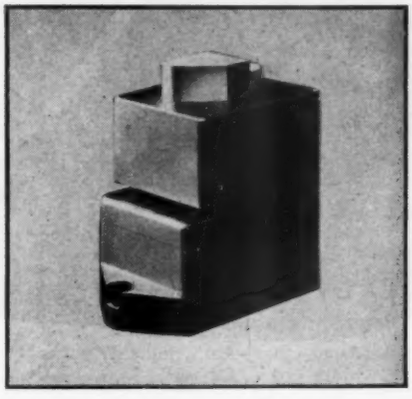


pletely automatic or semi-automatic according to the specified requirements. Steam can be generated from a cold start to pressures up to 300 lb. in less than two minutes. This generator is available in standard units of 500, 1,000, 1,500, 2,000 and 3,000 lb.

A single motor drives all accessory units with water blower and fuel feed controlled by steam demand. The staggered steel tube coil assembly may be easily removed for cleaning. Protection against explosion or escaping steam is assured by the continuous coil construction even though the steam generator has been subjected to external damage.

Wales Notching Die Used For Every Shape and Size Bulkhead

For notching aircraft bulkhead clearance and similar operations a Wales notching unit has been announced by The Strippit Corp., Buffalo, N. Y. The self-contained holder maintains constant punch and die alignment. The top portion of the punch fits into notches in the templet for instant reset-



ting and removing from rails, T-slotted plates or templets. These notching units, set up in series, can be used for every shape and size of bulkhead. Standard and irregular patterns are notched in one stroke of the press ram.

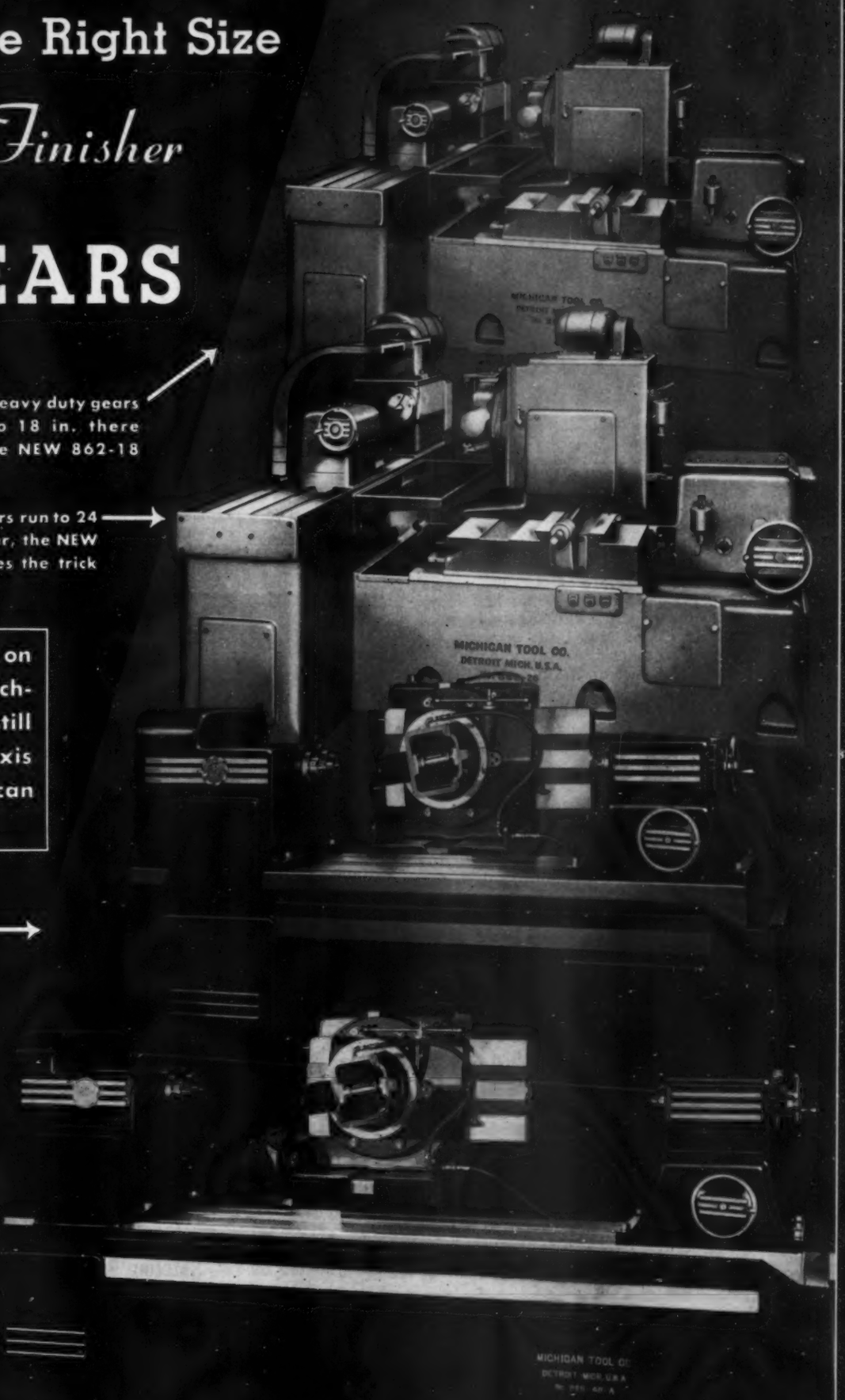
Gilbarco Develops Immersion, Flange Mounted Coolant Pumps

Gilbert & Barker Mfg. Co., Springfield, Mass., has introduced an immersion type coolant pump, Model CE, and a flange mounted type known as Model CF. Both types have a ¼-hp. motor totally inclosed against dirt and vapor or short circuiting and designed for continuous operation without overheating. This motor is equipped with two ball bearings permanently grease packed and requires no attention.

An open-type bronze impeller, statically and dynamically balanced, is secured to the lower end of the motor shaft with a key and locking nut. Four inlet ports in the pedestal of the Model CE provide for the coolant to enter the pump, while in the flange mounted type the coolant enters through the

How to pick the Right Size

Standard Finisher for BIG GEARS



For heavy duty gears up to 18 in. there is the NEW 862-18

Where gears run to 24 in. diameter, the NEW 862-24 does the trick

There is no size limit today on gears you can finish on "Michigans". If you want to finish still larger gears by the cross-axis shaving process, Michigan can supply you a 'special'.

If 3 ft. diam. gears are to be shaved you should use the NEW 865-36

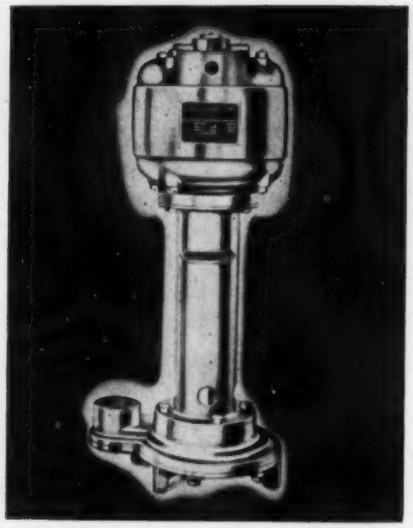
And for Gears Up to 4 ft. diameter there is the NEW "Michigan" 865-48

The machines shown here are new additions. They make even more complete the "Michigan" line of gear production equipment including rack and rotary shavers, lappers, checking equipment and gear cutting tools.

Pick your machine and ask us for a bulletin describing it

MICHIGAN TOOL COMPANY

7171 E. McNICHOLS ROAD • DETROIT, U. S. A.



inlet port in the center of the mounting flange.

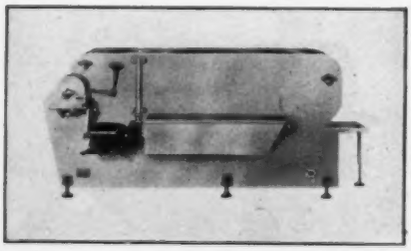
These pumps are self-priming and deliver coolant the moment the pump starts to operate and will handle liquids charged with filings and chips as large as 0.035 without stoppage or damage. The Model CE pump is designed particularly for grinding operations and recommended for handling any coolants which may become contaminated with abrasives. It is furnished with three different heights of pedestals for sump or tank mounting. All machining operations can be performed with the Model CF with the exception of grinding.

Capacities of the immersion type pump range from a fraction of a gallon to approximately 21 gal. per min. free flow. No relief or bypass valves are required when using retarded rates of flow. Quantities of coolant ranging from a fraction of a gallon to about 17 gal. per min, can be circulated with the flange mounted type pump.

Sturdy-Bilt Metal Parts Washer Removes Dirt and Oil

A metal parts washer for soaking, washing, drying and preparing metal parts either machined, finished or rough, and for complete metal assemblies has been introduced by Sturdy-Bilt Equipment Corp., Milwaukee, Wis. Besides the customary method of a powerful hydro washing this unit is suitable for a long dormant soak.

The parts are subjected to a long soaking in very hot light alkali solution water which loosens and removes dirt and chips. This is followed by very hot and powerful clean water washes and rinses to remove any remaining alkali, dirt or chips. Sufficient time is allowed to thoroughly dry the clean parts before reaching the unloading platform. No adjustments are necessary to clean a large variety of items. Chips are scraped into a receptacle at one end by a chip remover, and the basket may be easily removed to be emptied.



G. E. Introduces Dustproof Polyphase Induction Motors

Suitable for use under magnesium dust conditions a line of polyphase induction motors in sizes from 1 to 20 hp., NEMA frames 203 to 326 inclusive, has been introduced by General Electric Co., Schenectady, N. Y. The design of the new line of motors is based on a series of tests in which a sample 15 hp., 1800 r.p.m. motor was subjected to a cloud of fine magnesium dust while

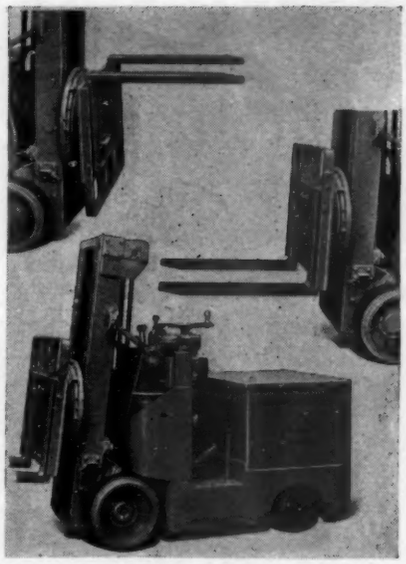
operating under heating and cooling cycles simulating several years' operation in an industrial plant.

These motors are totally inclosed, with a non-ventilated construction in the smaller ratings and a fan-cooled construction above 2 hp. Dust tightness without complicating assembly or disassembly has been made possible by cast-iron end shields, stator frames and fan housings. Other features include non-sparking bronze external fans, relatively straight and smooth external ventilating passages (for fan-cooled motors) to facilitate cleaning, a rotating labyrinth seal at the shaft opening and permanently sealed-in. leads.

Elwell-Parker Trucks Have Forks Mounted on Full Rotating Base

The Type F-23T center control truck introduced by Elwell-Parker Electric Co., Cleveland, Ohio, is available with forks on a rotating base capable of making a complete revolution. The base can be provided with stops to limit the swing to any angle up to 180 deg. if the work calls for only a partial revolution such as for body dumping into gondola cars.

The forks carry either suspended or supported loads at top position. When locked into place at the bottom, they



handle pallets or low skids without adjustment. For handling roll paper the forks are interchangeable with the rotating apron to pick up or deliver the roll on end or side.

This truck, with front wheel drive and rear wheel steering lever, is electric-powered. Up to 4,000 lb. can be handled and the truck will travel as much as 5 miles per hr. with a full load. The travel brake is foot-operated. The power is shut off and brake is applied automatically when the operator steps from his position on the truck. Tilting uprights can be extended to 140 in. high and are 83 in. high when telescoped.

Tal's Prestal Bending Machine Will Bend Bars Up to 180 Deg.

Introduction of a hydraulic portable pipe bending machine called Tal's Prestal has been made by Tal's Prestal Bender, Inc., Milwaukee, Wis., which produces smooth, even bends up to 180 deg. on iron and steel bar and pipe in one operation without moving the pipe. Operated by a pump handle at the rear of the assembly the forming heads are moved forward toward the pipe by the hydraulic piston of the machine. The

equipment is 32 in. overall length and weighs 98 lb. with the largest forming head, and can be set up without bolting in less than a minute. The unit is also suitable for pressing and pushing work.

NEW MATERIALS

Magnesium Fires Extinguished Rapidly With Carey MX Granules

Carey MX granules have been produced by the Philip Carey Mfg. Co., Lockland, Cincinnati, Ohio for extinguishing magnesium fires. It is claimed that this material is simple and effective when applied to magnesium and magnesium alloys in putting out the fire in a very few minutes. When spread over the fire the granules soften and seal the burning magnesium with an air-tight blanket, cutting off the oxygen supply. They remain free-flowing up to 175 deg. temperature and are not adversely affected by exposure to ordinary temperatures. A high percentage of the magnesium may be recovered after the fire has been extinguished.

Waverly Petroleum Produces Skid-Preventing Oil Absorbent

A granular substance called "Speedi-Dri" is offered by Waverly Petroleum Products Co., Drexel Bldg., Philadelphia, Pa. The material is fireproof and skid-preventing oil absorbent. It draws old stains from floors as well as removes new accumulations. Use of "Speedi-Dri" is claimed to reduce fire hazards and prevent accidents.

"Resi-Flex" Protective Coating Fireproof, Resists Exposure

A transparent resin with an unusual combination of properties for protecting metal, wood, fabric, paper and composition material under various types of exposure has been introduced by David C. Brown Co., 17532 Wisconsin Ave., Detroit, Mich., under the trade name "Resi-Flex." The coating is fire-resistant to 550 F. and will withstand direct exposure to flame for short periods. Because it is non-toxic and impervious to chemical attack, Resi-Flex can be used to line cans. An article coated with this material will not crack when bent through 140 deg. It is resistant to alkalies, inorganic acids, alcohols, gasoline and oil as well as scratch-resistant. The resin has high dielectric strength and good arc resistance.

Resi-Flex is made in air-drying and baking types which may be brushed or sprayed. The air-drying type is offered principally for protecting blueprints, photographs, tracings and manuscripts from fire, stain and water damage. Industrial types are baked at 250-375 F. for 6 to 30 min. depending upon size and type of material.

Men are Dying . . . Furnaces are Cold

—But you don't care!

IT IS difficult to believe that there are men who don't care—perhaps it's a case of not fully realizing the situation, but here are the facts.

Our boys are fighting, dying at the front. They need steel to protect them, weapons of steel to fight with, and yet some furnaces are cold that should be making steel night and day. With thousands of tons of scrap lying around the country, there is not enough gathered in to keep all the furnaces going, to say nothing of building up a back-log for the winter months.

Steel is usually made of 50% pig iron and 50% scrap. The blast furnaces are operating 24 hours a day making all the pig iron possible, so the only chance of increasing our steel output is to get more steel scrap.

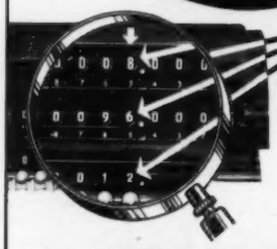
Your production scrap is, of course, collected in the routine way, but it is the broken and obsolete equipment, the old jigs, tools, dies, parts, etc. that are not moving, and they can not move without your authority.

So make a thorough recheck of your plant, storage rooms and equipment yards. Give orders to scrap everything that is not needed for current operations. The need is so critical that we can not urge you too strongly to act at once.

RYERSON STEEL-SERVICE

for calculating *Gearing* within fixed limits of a Decimal

and other uses!



All 3 factors stand in plain sight

MARCHANT

the electric calculator with straight-line figure dials for ALL 3 FACTORS!

Save the time of high-wage personnel now figuring with pencil and paper, or with eye-straining approximating devices having uncertain decimal points. A MARCHANT gives "the answer" quicker . . . correctly pointed off . . . and with *all 3* factors in plain sight for checking.

This is why MARCHANT is so popular in shop and drafting room . . . and explains why more and more firms are putting one within easy reach of each desk.

Try an Automatic Electric MARCHANT at our expense.

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HOME OFFICE: OAKLAND, CALIFORNIA, U. S. A.
Sales Agencies and Manufacturer's Service Stations Give Service Everywhere!

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- ☐ *Send* "Simplified Sq. Root and Cube Root Method."
- ☐ *Send pamphlet* "Conversion of Decimal Ratio to Common Fraction for Gear Design."

AM 8-20-42

Firm _____

Individual _____

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Use margin of page if necessary

TRADE PUBLICATIONS

AIR CIRCUIT BREAKERS Low-voltage air circuit breakers designed for use on alternating current circuits up to 600 volts and direct current circuits of 250 or 750 volts are described and illustrated in a 12-page catalog, No. 2150, prepared by the Roller-Smith Co., Bethlehem, Pa.

BEARINGS A 16-page catalog, No. 11, prepared by Neveroil Bearing Co., Wakefield, Mass., illustrates and describes oilless and self lubricating bearings, bushings and special shapes.

GAGE The Multichek, a precision instrument for the rapid inspection of mass production parts having several critical dimensions, is illustrated and described in a folder offered by The Sheffield Corp., Gage Division, Dayton, Ohio.

PRESSES The A. B. Farquahr Co., Limited, Hydraulic Press Division, York, Pa., has prepared bulletin No. 42-S-HP which illustrates and describes all types of forming, shell piercing and drawing, nosing, forging and extrusion, joggling, bending, straightening and gap type presses.

PRODUCTION COSTS The George S. May Business Foundation, 2600 North Shore Ave., Chicago, Ill., has prepared a report entitled "A Study of Production Costs as They Relate to Hours and Wages," available to schools, libraries and business executives.

PUMPS Centrifugal pumps are illustrated and described in Bulletin W-312-B2C issued by Worthington Pump and Machinery Corp., Harrison, N. J.

SALT BATHS The 14-page booklet published by E. F. Houghton & Co., 240 West Somerset St., Philadelphia, Pa., gives information on liquid salt baths for carburizing, annealing, reheating, tempering and neutral hardening.

NEW BOOKS

WELDING HANDBOOK—*Prepared by the American Welding Society's welding handbook committee and edited by W. Spraragen. 1,593 pages. Published by the American Welding Society, 33 W. 39 St., New York, N. Y. $6 in U.S.A., $6.50 elsewhere.*

Representing the work of 270 of the country's leading welding experts who cooperated with the American Welding Society's welding handbook committee, this new handbook is designed to give engineers an authoritative, up-to-date reference book on the technical phases of welding. While it is generally arranged in handbook style, the material has been prepared in a logical sequence with enough explanatory matter so that it may be used as a textbook in engineering schools and as a reference book in trade schools.

In order to best serve its purpose, the volume has been prepared to cover, first, the physics and metallurgy of welding, and the weldability of steels; second, the welding and allied processes; third, the materials used; fourth, training, inspection and safety; fifth, design considerations and testing of welding; and sixth, the applications of welding. There are 44 separate chapters in the handbook, each of the first 41 chapters having been prepared by a special committee working in cooperation with the handbook committee. The last three chapters give standard definitions of welding terms, a master chart of welding processes, welding symbols and instructions for their use, and testing terms, physical constants and conversion tables.

Throughout this handbook, the aim has been to make sure that the statements are accurate and recommendations authoritative. To this end, the committee selected outstanding authorities, from those available in each field, as members of committees preparing the respective chapters. The desirability of impartial treatment of subject matter has been fully recognized by these committee members and by the handbook committee.

Drawings, photographs, and tables are used throughout the handbook to increase its reference value. The handbook is fully indexed for ready reference.

ISA TOLERANCE SYSTEM—*Reprint of International Standards Association system of tolerances for cylindrical parts and limit gages, including tables converted from the metric to English system. 43 pages. Published by the American Society of Mechanical Engineers, 29 West 39th St., New York, N. Y.* $2.50.

This unified system of cylindrical fits was developed by the International Standards Association—a federation of national standardizing bodies of 20 countries. In the ten years required to formulate this system, every effort was made to make the fits interchangeable with those in existing national standards. Formulas for tolerances and allowances used as a framework represent the experience gathered in actual shop practice. To date 16 countries have adopted the ISA system.

The preparation of this reprint of the ISA tolerance system in the English language with the numerical values converted into inches was requested by the American Standards Association Sectional Committee B4 on the Standardization of Allowances and Tolerances for Cylindrical Parts and Limit Gages. The principal purpose of reprinting the ISA standards is to make it possible for the A.S.A. sectional committee and those in American industry particularly interested in this subject to have before them in convenient form an English translation of the complete ISA system of tolerances. The transla-

tion is intended to be helpful to members of the sectional committee in their study of existing tolerance systems and practices in this country and elsewhere during the efforts of the subcommittee to perfect the American tentative standards for tolerances, allowances, and gages for metal fits, B4a-1925.

The main features of the ISA tolerance system are: (1) The reference temperature for limiting gages is 20C. (2) The nominal size range extends from 0.04 to 19.69 in. and is subdivided into a number of sub-ranges. (3) Fits are given in the Basic-Hole and Basic-Shaft system. (4) Tolerances are unilateral. (5) The series of shafts and holes may be combined at will; however, for the guidance of designers in the selection of suitable fits there is included a series of full-shaft combinations covering the most common requirements in the different branches of industry. (6) Manufacturing tolerances on a "go" gage must lie within the limits of the workpiece but the gage may be used until it has worn a definite small amount past the "go" limit of the work. A plus or minus variation is permitted from the nominal size of a "not go" gage.

•

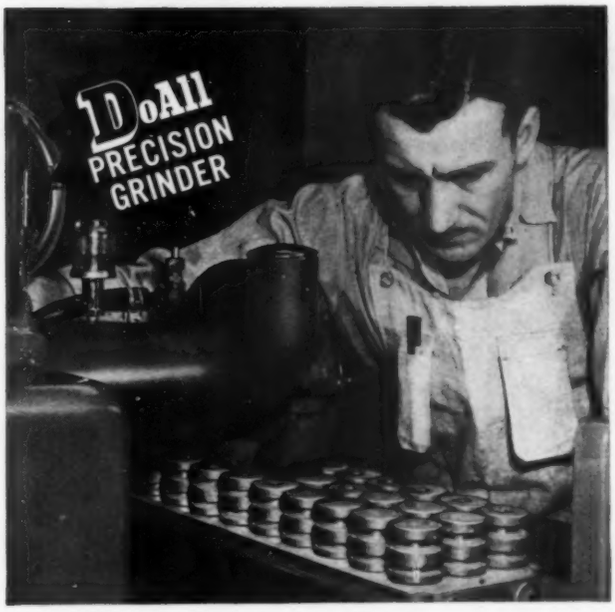
PLASTICS—*By J. H. DuBois, Plastics Department, General Electric Company. 295 pages. Published by American Technical Society, Drexel Ave. at 58 St. Chicago, Ill. $3.*

Written to serve as a text book for students and as a reference handbook for designers, this volume discusses basic information concerning the various plastics, their history, origin and raw materials sources; their physical, chemical and electrical properties, and their limitations; methods of their fabrication and the essential information concerning their design. The book is illustrated with photographs of a number of examples of modern applications of plastics, and with drawings showing typical design problems, as well as typical molding dies. A number of tables give physical and mechanical properties of the various classes of plastic materials. While some information is included regarding the machining of these plastics, it is believed that the data on this subject is too general for much use in the shop.

SEEN and HEARD

Can Abrasive Dust Be Reclaimed?

Every once in awhile someone in a shop employing a large number of grinders sees a possibility of making a major saving by recovering the grit from the dust produced on his grinders. Such a case came to our attention recently. We believe that this would not be economically sound, but just to check ourselves we wrote to two of the larger suppliers of abrasive materials, to in-



Surface grinding Plug Gauges, showing use of coolant

A "NATURAL" IN WAR WORK PLANTS

• Read what the Plant Manager of one large mid-west factory writes:

"Recently we installed one of your Surface Grinders. It has been operating on a 24-hour-a-day basis, grinding intricate and precise parts used on gun mounts and pumps.

"It is producing the finest work of all our grinders, both as to surface finish and accuracy. Production on the DoAll is *double that of any similar grinder* we have."

The DoAll comes in two sizes, adaptable to wet or dry grinding, with 7" or 10" wheel.

Send for literature giving construction features and other interesting data about these better grinders.

SAVAGE TOOL CO.

Dept. AM Savage, Minn.

6 REASONS WHY THIS GRINDER IS THE BEST

EXTRA WEIGHT
OVER ONE TON
EXTRA BEARING AREA
1140 Sq. In. of Bearings HAND SCRAPED
DIRECT DRIVE
" " BALL BEARINGS IN SPINDLE ARE SUPER ACCURATE
MASSIVE COLUMN
POWER HEAD RESTS ON A PILLAR OF STRENGTH
PROTECTIVE SADDLE
MECHANISM IS FULLY SEALED
NEW HYDRAULIC DRIVE

MEMORANDUM

To Production Executives:

If material or specification changes are necessary—requiring changes in tools, feeds or speeds—check the cutting fluid factor with

Stuart Oil
Engineering Service

Selecting the right cutting oil to fit conditions, which sometimes change over night, will eliminate one possible source of time-wasting, production-slowing trouble. We are equipped and ready to help you.

Stuart's
CODOL
LIQUID GRINDING COMPOUND
Meets every test for the ideal Modern Grinding Compound

Stuart's
Thred Kut
HEAVY DUTY CUTTING OIL
Recommended by America's leading machine tool builders

Stuart's
SOLVOL
LIQUID CUTTING COMPOUND
For carbide tools and where an "aquamix" solution is recommended

Stuart's
"SUPER-KOOL"
AMERICA'S FIRST TRANSPARENT SULPHURIZED CUTTING AND DRAWING OIL

For All Cutting Fluid Problems
D. A. STUART OIL CO.
Chicago, U.S.A. • LIMITED • Est. 1865
Warehouses in All Principal Metal Working Centers

quire about the possibility of reclaiming and reusing abrasive grit.

The replies were almost identical. In the first place, grinder dust usually contains too many impurities to be reused direct as an abrasive of any kind. In order to reclaim the abrasive, it is necessary to give it a thorough magnetic separation to eliminate iron, and then later to thoroughly wash and classify it in order to get graded sizes which are essential for good lapping compounds or other abrasive materials. Such a process is expensive to operate, and the reclaimed abrasive would cost more than new materials.

Company Band

"What's this about a company band?" Old Man Johnson was talking to his foremen at the weekly meeting where plans and proposals were hashed over.

"Just an idea some of the boys had," said Bill Davis, assembly shop foreman. "They wanted to know what you think of it. Sounds all right to me, but I don't know when they'll find time to practice."

"I'm for it," said Old Man Johnson, "especially if the band is recruited 100 percent from the assembly department; they can practice during working hours."

"You don't mean that, Mr. Johnson," exclaimed Bill. "That would disrupt the whole shop."

"I mean it all right," said Johnson, "with certain strings attached. I'd only let a man tune up when he got parts for assembly that wouldn't fit together without a lot of extra work. Then he'd be privileged to drop everything and start tooting on his slide trombone or whatever he played."

"Now that you put it that way, Mr. Johnson, I'm in favor of it too. If the assemblers stopped scraping and filing and let out a few blasts maybe the parts would come right for a change."

"That's the idea exactly," said Old Man Johnson. "There'd be less disruption in the long run than there is now with all this running around for tools and clamps to make wrong parts right. But maybe these machining foremen would like to take another crack at straightening things out before they have to listen to your amateur clarinetists perform."

Overmotoring a Crime

Because of "overmotoring" up to 25 percent more material and labor are now going into the production of motors than is needed for the work the motors are being called upon to do, according to L. A. Umansky, assistant manager of General Electric's industrial engineering department.

Conservatism in motor selection, however commendable in normal times, must now be discarded. It should be remembered that although modern motors are lighter for the same horsepower than those of a few years ago, they are just as conservatively rated

by the manufacturer who has already designed into the motor a margin of safety to meet reasonable overloads. Since the capacity of the power system is often based on the installed horsepower of motors, careless motor selection will result in using cables, buses and other electrical equipment which is heavier and uses more copper than is necessary. Mr. Umansky recommends the following five principles to follow in motor selection:

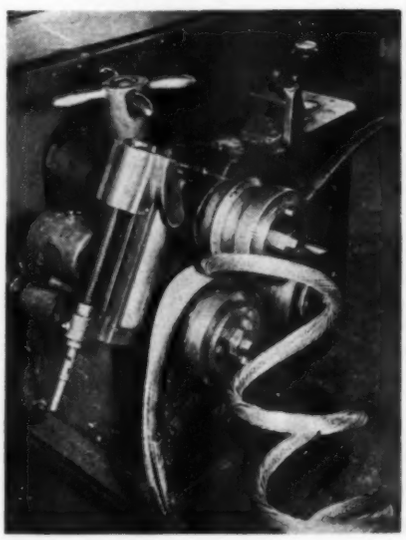
1. Avoid piling up of safety margins.
2. Do not arbitrarily select the next larger rating.
3. Utilize, wherever possible, the available service factor.
4. Don't use integral horsepower motors for voltages less than 440 volts unless unavoidable.
5. Bring high-voltage power to the load center.

Cable Salvage Machine

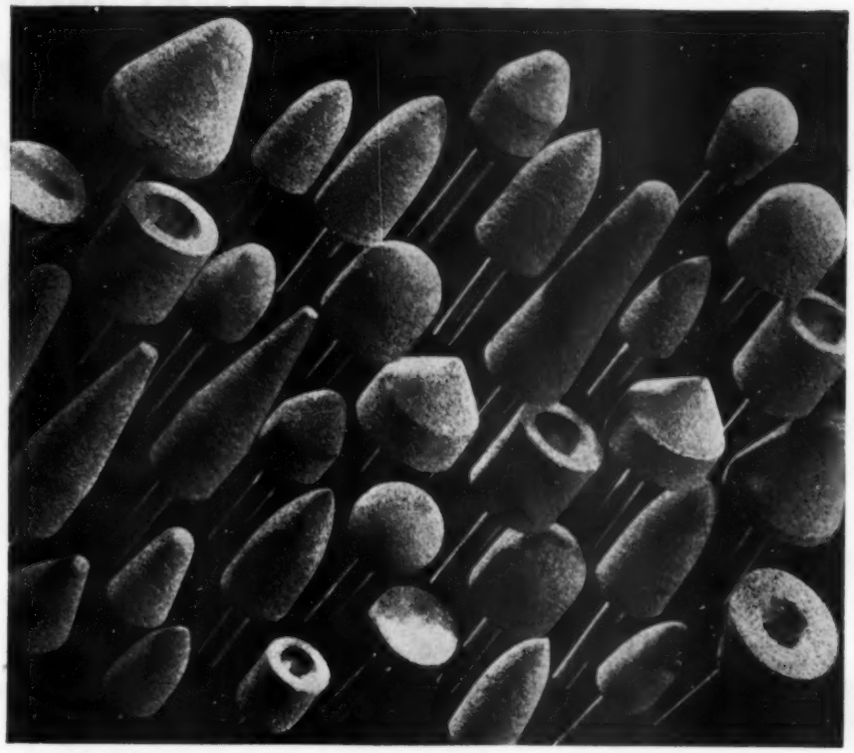
Until recently it has been general practice to burn the rubber and cloth insulation off scrap electric cable to salvage the copper. Seeking a method of salvaging the cable rubber, the Timken Roller Bearing Company experimented with a standard Buffalo bending roll machine. This consists of three smooth wheels, two of which are in tandem beneath a third wheel which is centered above them. Varying pressures are exerted upon the material to be bent by raising or lowering the upper wheel.

One lower wheel was removed and replaced with a notched gripper wheel. A sharp center-flanged wheel replaced the upper wheel. No change was made in the third wheel. The gripper wheel feeds the cable between the flanged cutter wheel and the pressure wheel. The cable is sliced open and peeled simultaneously. The cloth cable cover drops away from the rubber leaving the rubber and copper cable in a salable condition.

Cables ranging in size from ⅝ to 2 in. are handled at the rate of about 6 ft. per min.



FINISHING THE *JOB* BEHIND THE LINES



Keeping up with Uncle Sam's victory drive for more tanks and guns and planes, Chicago Mounted Wheels are doing a big finishing job in shops everywhere—taking care of every kind of delicate or tough grinding job faster, smoother and better.

CHICAGO MOUNTED WHEELS

Made of V/T Super Bond, they have real stamina, give unmatched performance and last 150% to 300% longer than ordinary wheels.

Chicago Wheels were the first small wheels mounted on steel shanks. Today there are over 200 different shapes to serve you—made in a variety of abrasives, grains and grades, mounted on shanks of various lengths and diameters of 1/4", 3/32", 1/8" and 3/16".

TRY ONE ABSOLUTELY FREE

Tell us the kind of job, size and wheel speed you use, and we'll send you a test wheel postpaid.

BRAND NEW CATALOG—Just off the press, this book is prepared in the modern manner—loads of illustrations, concise descriptions of the complete line of Chicago Mounted Wheels.

HI-POWER GRINDER

A real production grinder that is saving many man hours. Weighs 3 pounds, yet is so well balanced that fatigue is practically eliminated. Has enough power to drive a 2½" diam. wheel. Speed 17,000 r.p.m. In case with 3 Chicago Mounted Wheels, Drum Sander and Bands, extra Collets, Wrenches, Dressing Stone, $38.50.

CHICAGO WHEEL & MFG. CO.

Makers of Quality Products for 40 Years

1101 W. Monroe St., Dept. AT, Chicago, Ill.

☐ Send Hi-Power Catalog
☐ Free Wheel Size .....

Name AT-8

Address .....

A COMPANY THAT MADE BILLIONS OF METAL UNITS LAST YEAR IS READY TO DO MORE War

Continental Can Company wants to work with any industry as a prime or sub-contractor of sheet metal work, stampings and sub-assemblies

Here is what we offer:

▶ 45 plants conveniently located from coast to coast.

▶ 7,738,500 square feet of floor space, part of which is available for additional war work.

▶ 16,000 workers (including machinists, engineers, draftsmen, tool and die makers) skilled in mass production of metal units.

▶ 37 years' experience in making metal containers of every size and shape—plus bottle caps, fibre containers, metal household items.

▶ Current experience in contract work for the Army, Navy and Air Corps.

▶ Precision manufacturing machinery for many kinds of metal work.

▶ 7,000 stable sources of supply for materials and equipment.

▶ Contacts with more than 12,000 companies we serve.

▶ Credit: rated highest by all agencies.

▶ The resources (plants, laboratories and facilities) of a company with 35,000 stockholders and an annual business in 1941 of $136,652,016.

▶ An alert, progressive management eager to help you with your production problems and to serve America.

▶ A War Products Council representing all major departments of the company to coordinate and expedite the handling of war business inquiries.

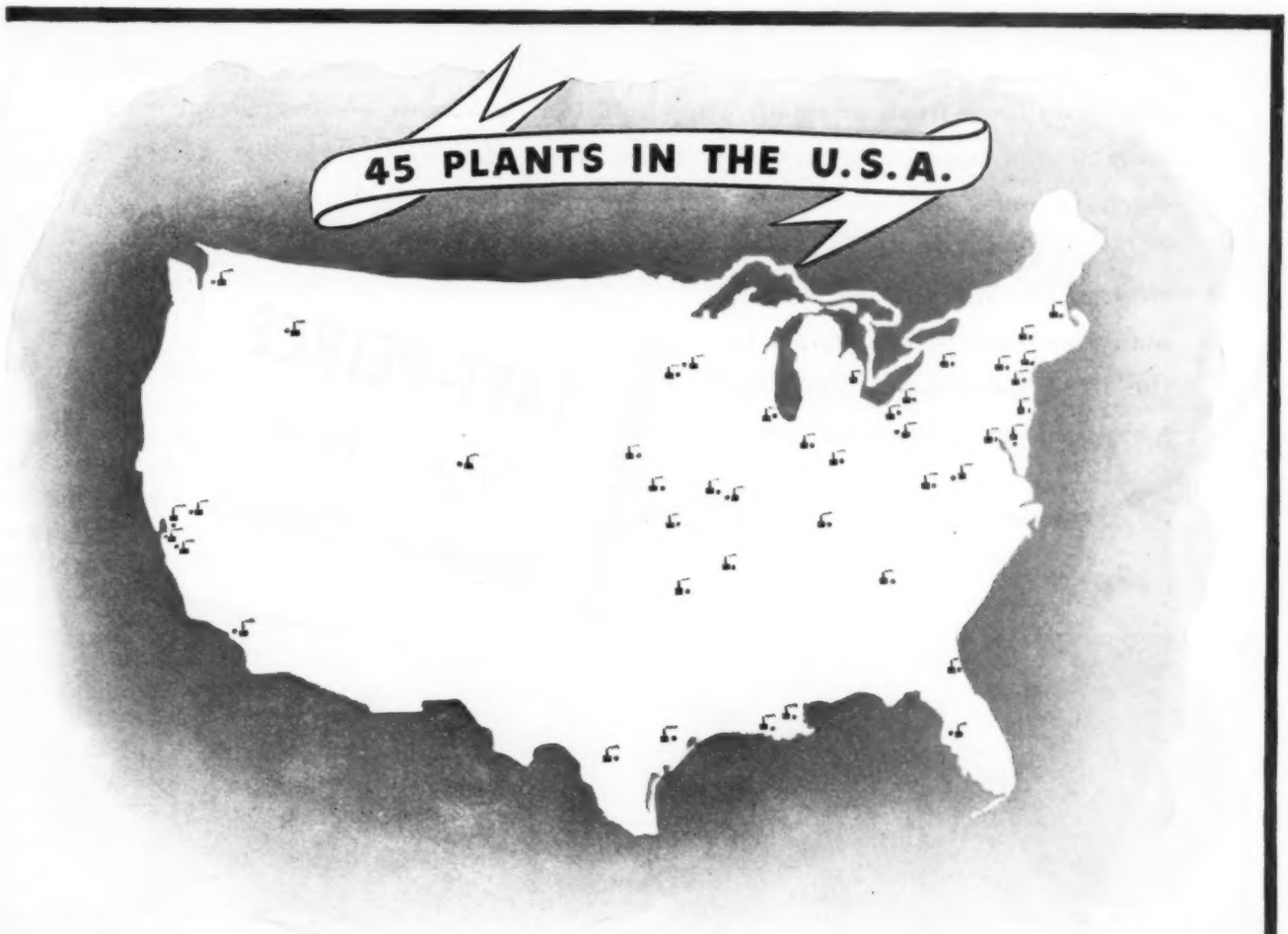
This council is organized to give you quick action . . . to help you or tell you promptly what you want to know about Continental's ability to handle any job. Write, wire or phone War Products Council, Continental Can Company, 100 East 42nd Street, New York City, or any sales office.

NOTE: *Continental is still turning out "packages to protect America"—cans to carry needed food to our armed forces, to our Allies, and into American homes. We will continue to make these cans—as well as other containers for essential products as defined by WPB.*

CONTINENTAL CAN COMPANY

100 EAST 42nd STREET, NEW YORK CITY

work



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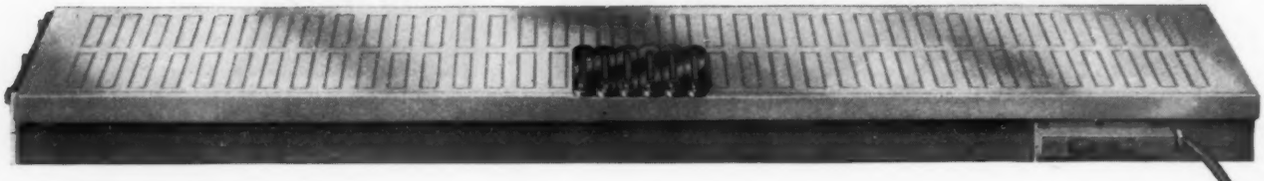
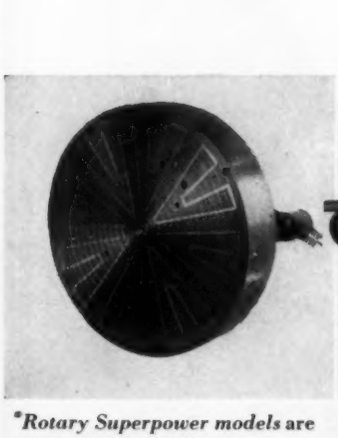
Increase the Production ...Widen the Work-Range

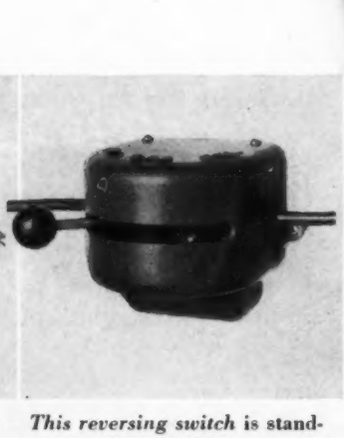
NOT ONLY OF GRINDERS, BUT OF MILLERS, PLANERS, SHAPERS, LATHES

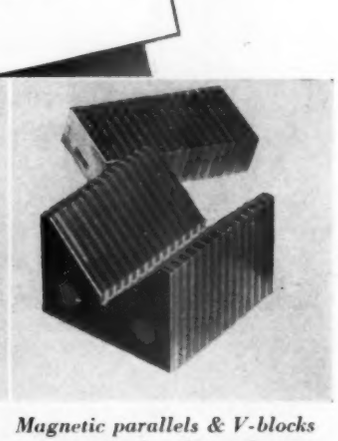


SUPERPOWER MAGNETIC CHUCKS save critical time in setting up large work or small. They hold the work more securely because of their denser magnetic flux, which makes them adaptable to a wide variety of machine tools. ***Yet Superpowers, manufactured only by Taft-Peirce, cost no more than ordinary magnetic chucks.*** **The full line, as well as many accessories, are shown in the 1941 Handbook. Write for a copy on your letterhead today.**

TAFT-PEIRCE
Superpower
MAGNETIC CHUCKS







******Rotary Superpower models* **are made in many different sizes, and styles of face plates.**

This reversing switch **is standard for all sizes which are rated less than 200 watts.**

This double-unit demagnetizer **quickly eliminates the last traces of residual magnetism.**

Magnetic parallels & V-blocks **increase chuck utility and versatility. Universal in application.**

THE TAFT-PEIRCE MANUFACTURING COMPANY · WOONSOCKET, RHODE ISLAND

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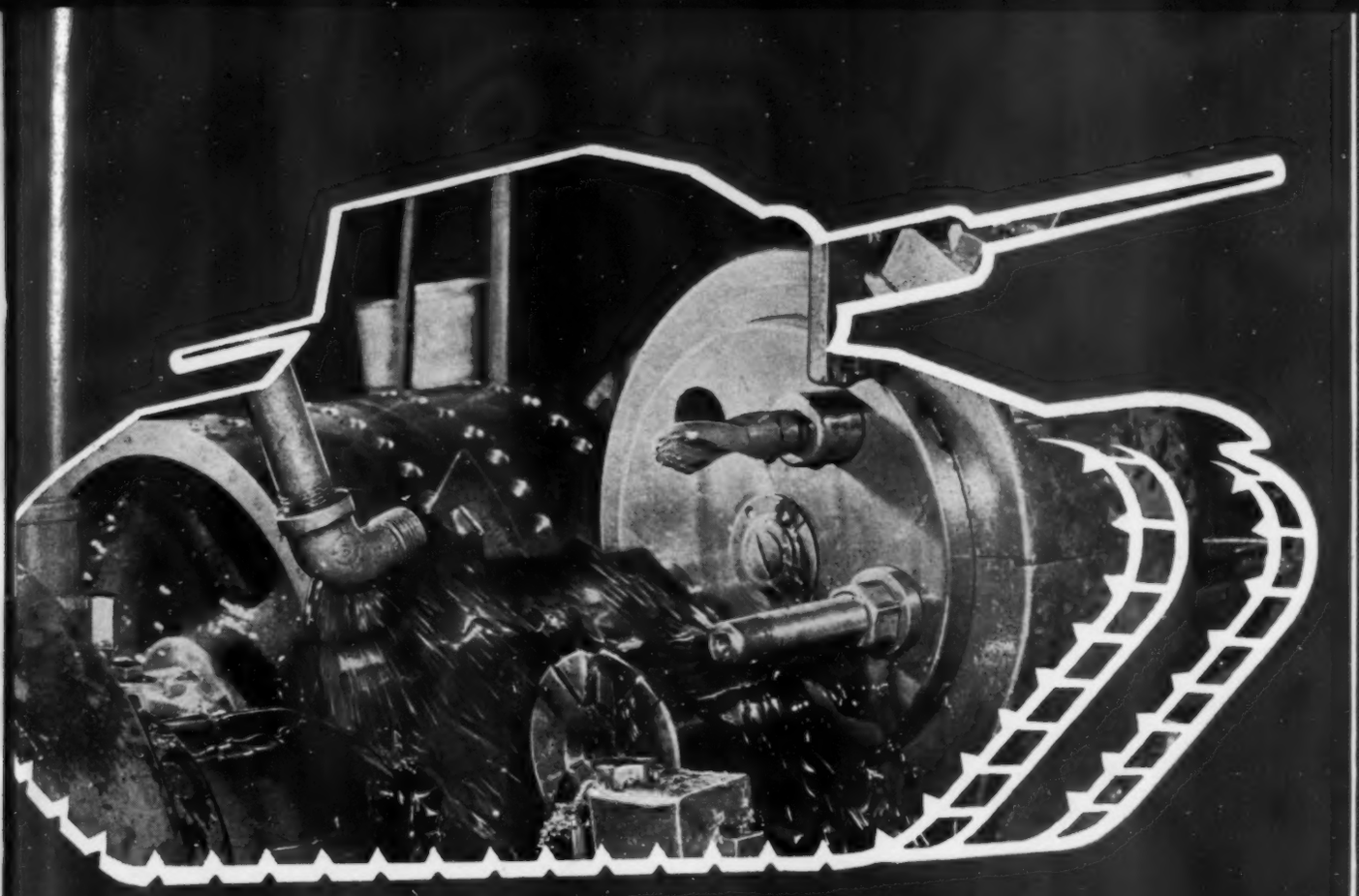

HOW TO SOLVE NEW CUTTING OIL PROBLEMS IN YOUR RETOOLING..FASTER

• How to get the speed, finish, and accuracy needed to meet production requirements? What cutting oils can help? You not only must have the answers—but you need them NOW!

New cutting oils and coolants are available, made to meet the problems you are facing. They have been tested and are in daily use by plants to do the same kinds of jobs you are handling.

Standard Oil Engineers have been working with many plants during retooling. They know what is needed to get high finish at high rates of speed. They know how to help you meet the close tolerances allowed. They have the combined experience of many plants, many jobs, working on new metals, with new tools. They are glad to share their knowledge with you, to help you do the job America asks you to do.

Ask a Standard Oil Engineer or metal-working specialist to help you. He probably can suggest a method or a product that will turn out your end of the job faster—better.

Call or write any Standard Oil Company (Indiana) office in the Middle West, or write 910 South Michigan Avenue, Chicago, Illinois.

Typical Cutting Oil Problems Standard Oil Engineers Have Helped Solve

JOB—Forming cartridge cases.
PROBLEM—Compound caused punch to "brass-up" and become oversize, requiring frequent changes.
RESULT—Stanostamp recommended. Eliminates brassing without excessive wear on punch. Job runs cooler and was speeded up 10%.

JOB—Form grinding threads on machine gun barrels.
PROBLEM—Speed up operation.
RESULT—Special compounded oil developed, permitting higher wheel speeds and feeds without burning work.

JOB—Machining tough aluminum alloy on airplane parts.
PROBLEM—Eliminate rough finish and rapid tool wear without use of lard oil.
RESULT—Developed special cutting oil that gave required finish and tool life with no odor development.

OIL IS AMMUNITION...USE IT WISELY

Copr. 1942, Standard Oil Company

STANDARD OIL COMPANY (INDIANA)

LUBRICATION ENGINEERING...LUBRICATION ENGINEERING...LUBRICATION ENGINEERING...LUBRICATIO

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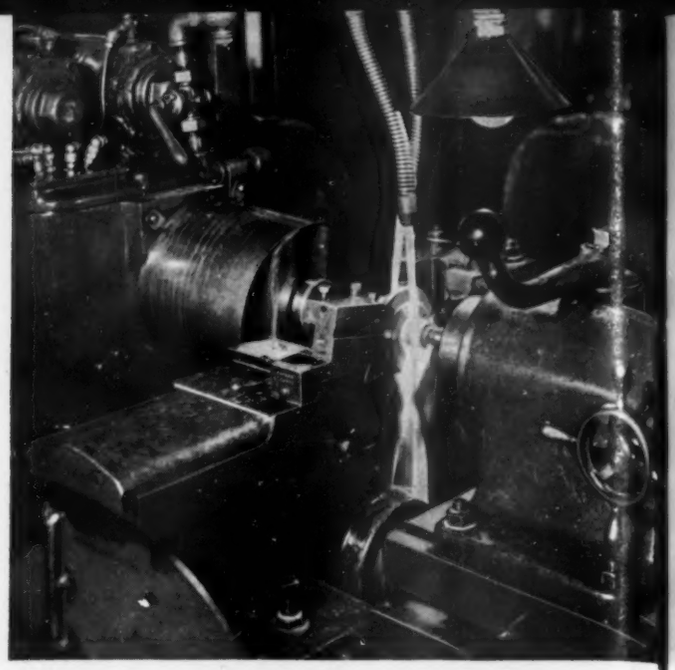


REPLACES PLANT-MIXED CUTTING OIL . . . SAVES TIME AND TOOLS

Here's an example of how Standard Engineers can help you cut corners on production time. An electrical equipment manufacturer used a base oil and paraffin oil mixed in the plant. Under normal operation, this cutting oil was satisfactory. But defense work speed changed the story. The mixture wasn't uniform. Tool life suffered. Even the time and labor required for mixing became important.

A Standard Oil Engineer recommended a tested refinery-blended cutting oil. Tool life jumped 300% with this

uniform product. Each batch of oil gives the same results.

Your problem may be different, but the way to solve it is the same—get a Standard Oil Engineer's help.

HERE'S WHERE YOU'LL FIND A STANDARD OIL ENGINEER

Just phone any local Standard Oil Company (Indiana) office in the middle western states listed below, or 910 South Michigan Ave., Chicago, Illinois. In Nebraska, call or write Standard Oil Company of Nebraska at Omaha.

COLORADO • ILLINOIS • INDIANA • IOWA • KANSAS • MICHIGAN
MINNESOTA • MISSOURI • MONTANA • NORTH DAKOTA • WYOMING
SOUTH DAKOTA • WISCONSIN

OIL IS AMMUNITION . . . USE IT WISELY

STOPS RUSTING OF PARTS... NO SEPARATION WITH SUPERLA SOLUBLE OIL

Today, time spent cleaning deposit-coated coolant lines or mixing balky coolant emulsions puts the brakes on war production. Try Superla Soluble Oil. It mixes easily, even with hard water, without any water softening agents. It doesn't separate and form deposits in tanks and coolant lines. Because the oil is dispersed evenly throughout the emulsion, a thin film of rust-preventing oil is left on the work. A Standard Oil Engineer can recommend the mixture you need for the best tool life and rust protection on your work.

KEEP OIL SYSTEMS CLEAN WITH INDOILS

Sludge formation, and clouding of sight feed oilers on a number of grinding machines in a Michigan war-goods plant is typical of the lubrication problems on which a Standard Oil Engineer can help you. Here, the Engineer recommended Indoil—it had eliminated this trouble in many plants—it did here. Machines now run for months without cleaning or changing oil.

STANDARD OIL COMPANY (INDIANA

Minutes that used to be hours

IN THIS race to give America the mightiest air armada of all time, every minute counts. Aircraft builders are making the most of these minutes when they use Masonite* Die Stock in the fabrication of fixtures for assembling formed metal parts.

Only one-sixth the weight of steel—yet strong enough for tough production jobs—this new, semi-plastic material is helping to produce assembly fixtures in a fraction of the time formerly required.

Masonite Die Stock may be worked with either metal working and cutting tools or with high-speed pattern shop equipment. It can be drilled and tapped for threads for attaching clamps and gauges. Also press fit drill bushings can be inserted.

Besides its increasing use in the aircraft industry, Masonite Die Stock is also finding high favor with other manufacturers who work with thin gauges of steel and aluminum or aluminum alloys, in sheet form.

Available in thicknesses of ¼ to 2 inches . . . in sizes of 48 x 72 and 48 x 144 inches. For further particulars, fill out and mail the coupon below.

*TRADE-MARK REG. U. S. PAT. OFF. "MASONITE" IDENTIFIES ALL PRODUCTS MARKETED BY MASONITE CORPORATION. COPYRIGHT 1942, MASONITE CORP

Masonite Die Stock used in an assembly fixture for the leading edge of a Curtiss-Wright "Troop Ship of the Skies."

MASONITE CORPORATION, *Dept. AM-8,* **111 W. Washington St., Chicago, Ill.**

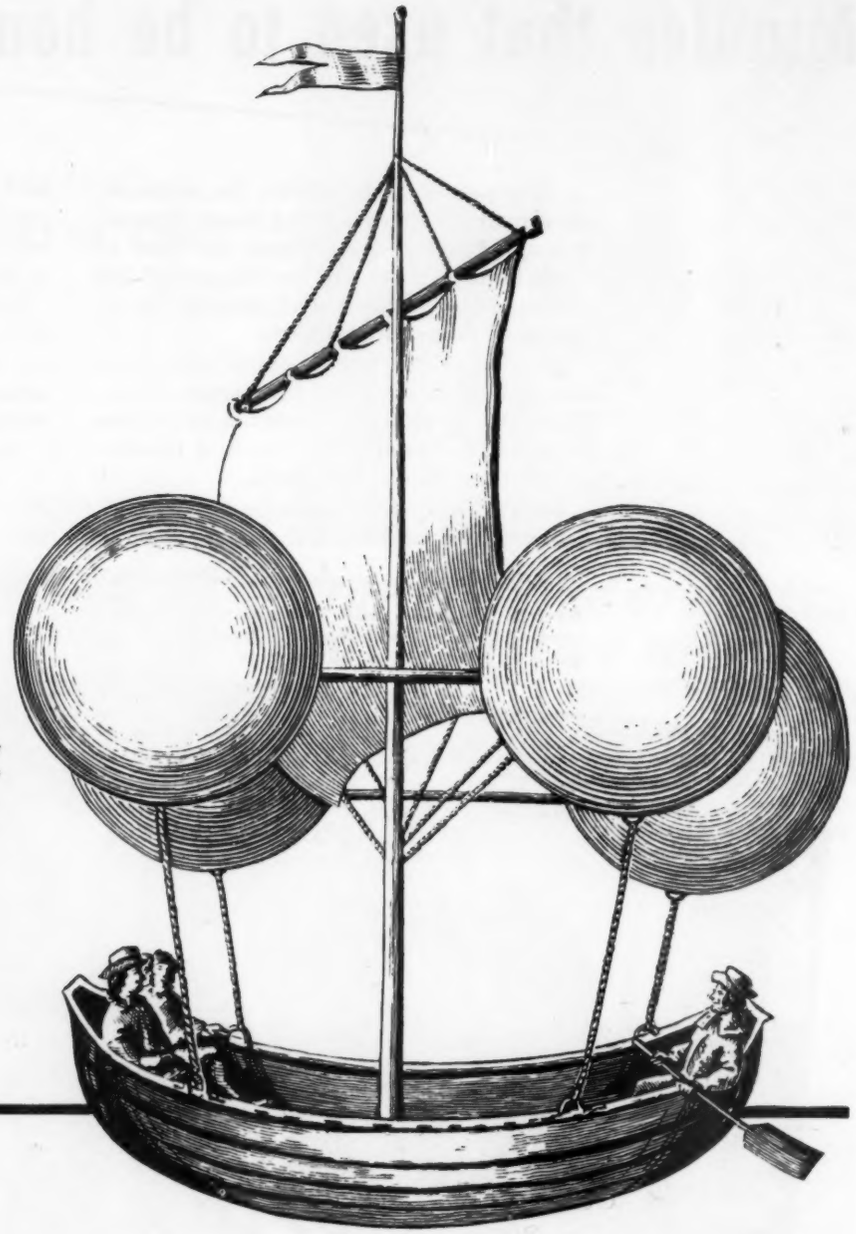
Please send me illustrative literature and complete information about Masonite Die Stock.

Name and firm _____

Address _____

City _____ *State* _____

Every new idea may not click...



—but those that do make history!

Shell men may not ring the bell *every* time they advance an idea, but their practical suggestions *have had* real dollars-and-sense value to manufacturers in dozens of different industries. Time and again their suggestions have been the starting point for increased production, longer machine and tool life, improved product finish.

Take the case of the manufacturer who is machining gears for army tanks... By using Shell's improved method of balanced lubrication, gears were turned out 50% faster; finish was improved. And this was accomplished without the purchase of any new equipment.

Because you are looking for worth-while ideas like this, why not "talk it over" with the Shell man? Call him in today.

SHELL LATA OILS *for Cutting*

SHELL

Planes are Forgings

Trainers, pursuits, bombers, flying fortresses—they're faster, more durable and better able to withstand the gruelling punishment of long distance flights and the rigors of combat because of the broader use of tough, stress resistant forged parts. Wing, strut, fuselage, engine and bomb rack forgings are typical parts that we are producing for the aviation industry. Our production has grown, in one short year, from a few parts made for one plane builder to thousands of parts shipped daily—seven days a week to aviation companies all over the country.

We're in this war to win—and if we can help you with forgings for planes, tanks, ships, guns or machine tools, we'll find some way to expand our already over-taxed production facilities.

We're beating plow shares into swords—for democracy.

Proudly we fly the Navy "E" flag awarded for excellence and proficiency in the production of Naval Materiel.

KROPP FORGE COMPANY

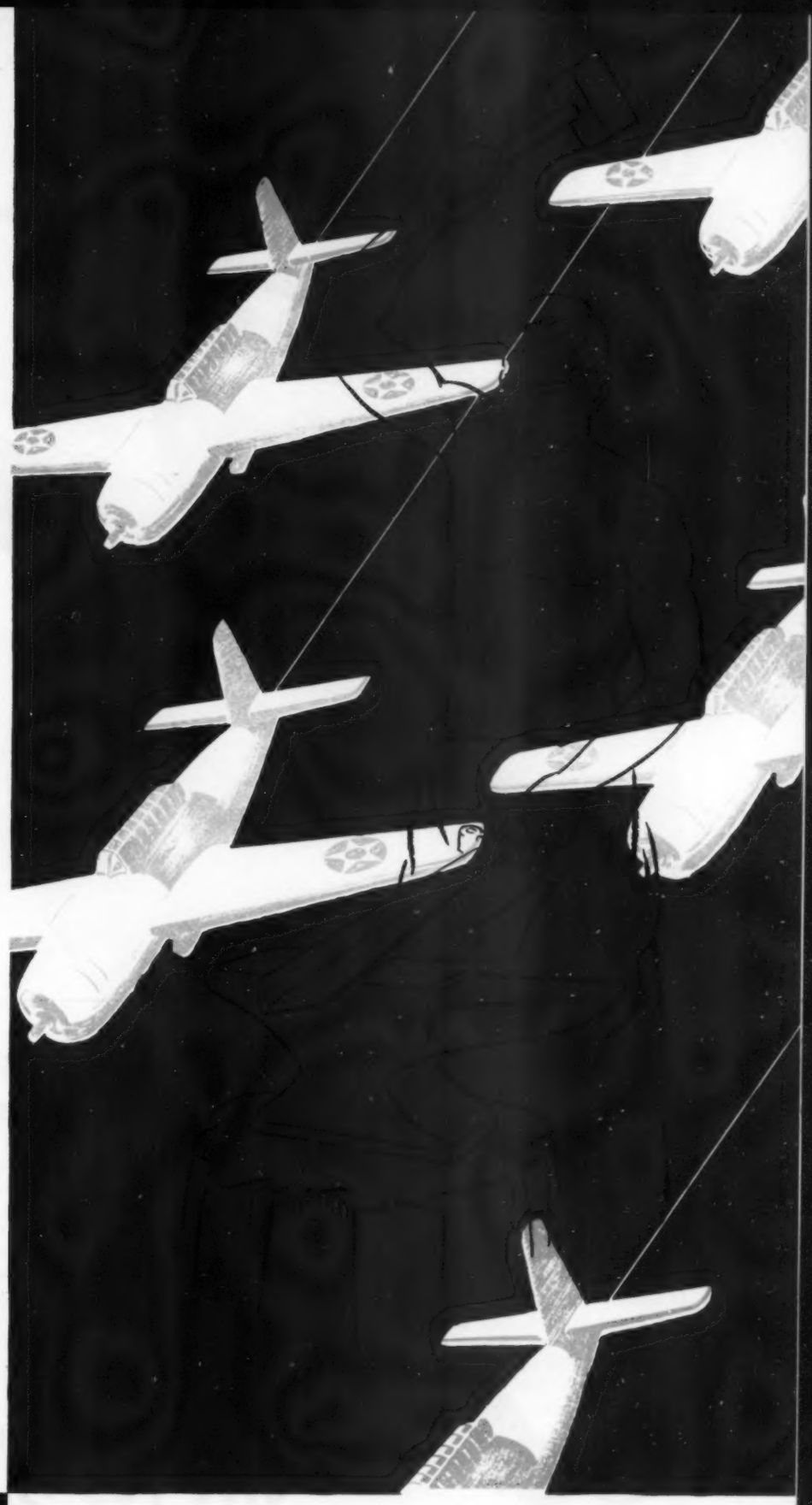
Makers of Drop, Upset and Hammer Forgings for Guns, Planes, Tanks, Ships and Machine Tools.

"World's Largest Job Forging Shop"

5301 W. ROOSEVELT ROAD, CHICAGO, ILL.

Representatives in Principal Cities

SERVING INDUSTRY SINCE 18 37 K KROPP FORGE CO. OVER 100 YEARS



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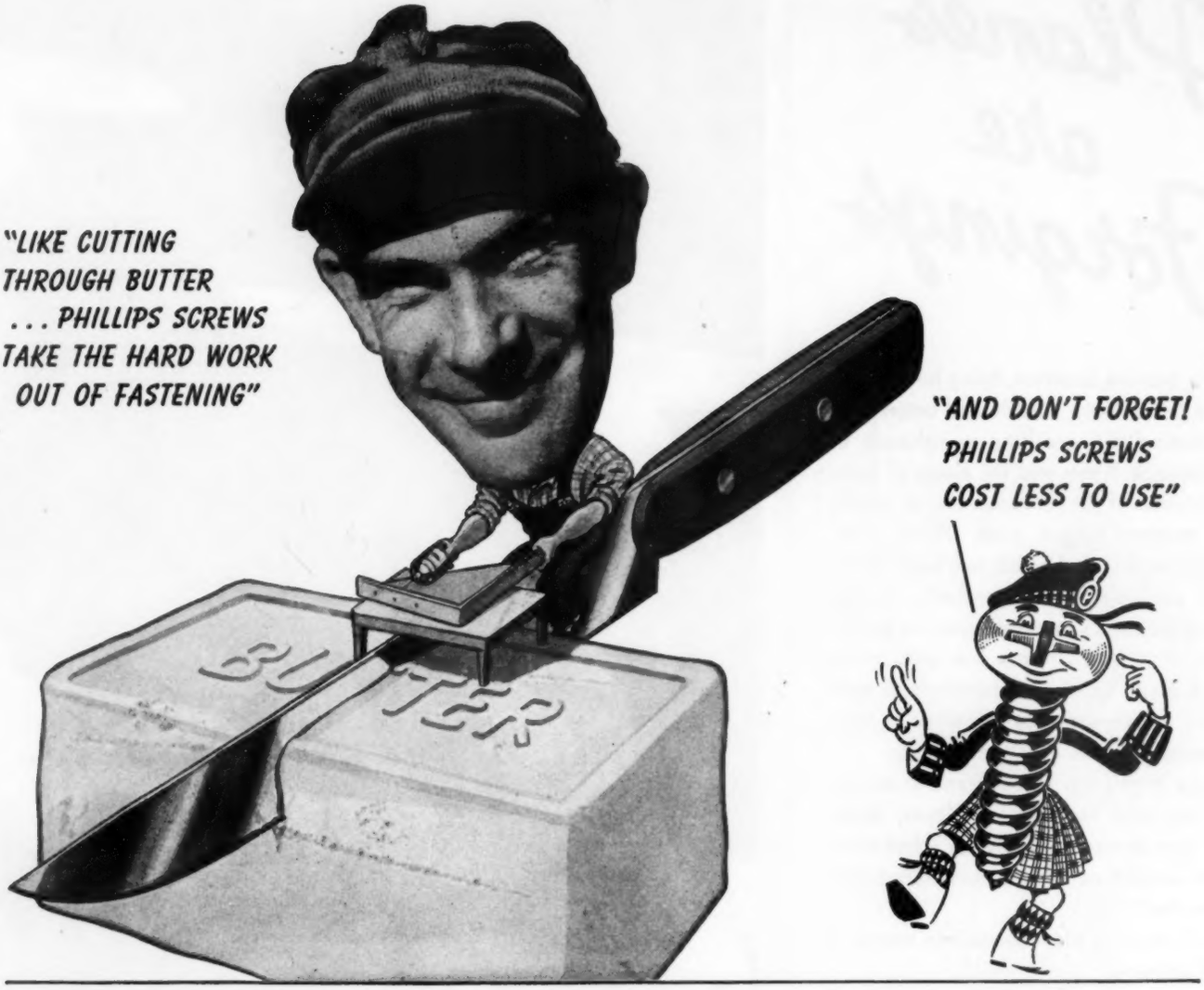

"LIKE CUTTING THROUGH BUTTER ... PHILLIPS SCREWS TAKE THE HARD WORK OUT OF FASTENING"
"AND DON'T FORGET! PHILLIPS SCREWS COST LESS TO USE"
BUTTER

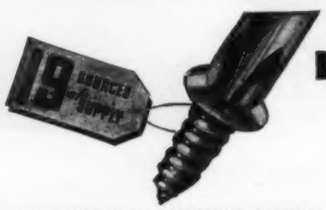
Easier Screwdriving • Freedom from Accidents • Tighter Seating = 50% Less Assembly Cost with Phillips Screws

You'd know the difference if you were doing the job. In fact, executives who have their own home workshops are usually the quickest to see the advantages of the Phillips principle and adopt it for their firm's assembly work.

It really *is* easy to drive Phillips Recessed Head Screws. You get a better "grab" on the screw because the driver point and Phillips recess make a snug fit. There's no danger of the driver slipping, so you don't have to spend a good part of your effort holding it in — you just keep *turning*. And there are more jobs on which you can use power drivers.

Translate this *ease of driving* into time and then time into dollars. An operator can, on the average, cut fastening time *in half*. Figure it out for yourself — then add the savings you get from using fewer screws (better holding power often reduces number or size of screws needed), spoiling fewer screws (no split screw heads) and eliminating the cost of resurfacing screw-driver scars.

The Phillips Screw is certainly the *modern* fastening method — which means "better" and "more economical." Any of the firms below can supply you.



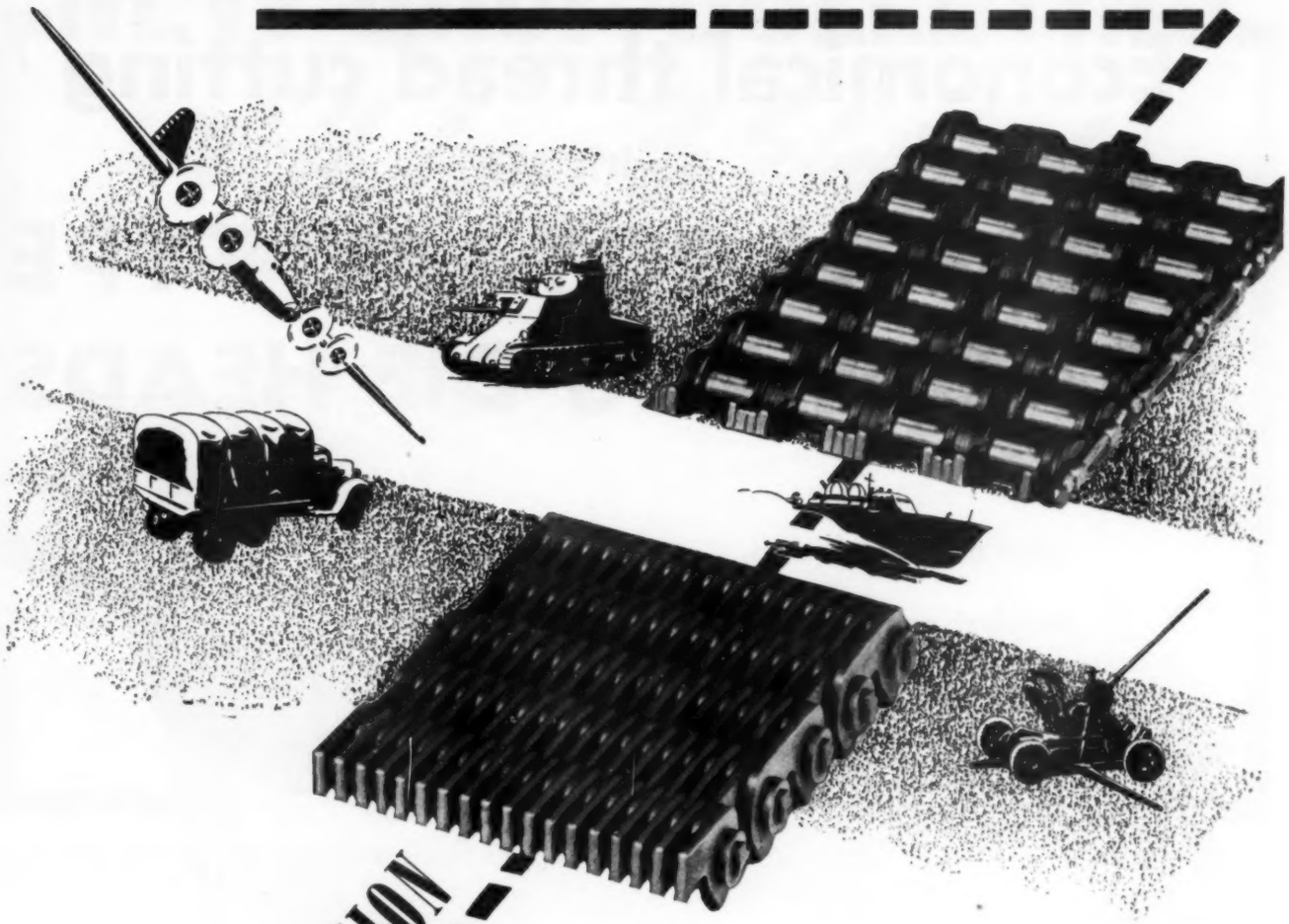
PHILLIPS RECESSED HEAD SCREWS

GIVE YOU *2 for 1* **(SPEED AT LOWER COST)**

WOOD SCREWS · MACHINE SCREWS · SHEET METAL SCREWS · STOVE BOLTS · SPECIAL THREAD-CUTTING SCREWS · SCREWS WITH LOCK WASHERS

American Screw Co., Providence, R. I.
The Bristol Co., Waterbury, Conn.
Central Screw Co., Chicago, Ill.
Chandler Products Corp., Cleveland, Ohio
Continental Screw Co., New Bedford, Mass.
The Corbin Screw Corp., New Britain, Conn.
International Screw Co., Detroit, Mich.
The Lamson & Sessions Co., Cleveland, Ohio
The National Screw & Mfg. Co., Cleveland, Ohio
New England Screw Co., Keene, N. H.
The Charles Parker Co., Meriden, Conn.
Parker-Kalon Corp., New York, N. Y.
Pawtucket Screw Co., Pawtucket, R. I.
Pheoll Manufacturing Co., Chicago, Ill.
Russell, Burdsall & Ward Bolt & Nut Co., Port Chester, N. Y.
Scovill Manufacturing Co., Waterbury, Conn.
Shakeproof Inc., Chicago, Ill.
The Southington Hardware Mfg. Co., Southington, Conn.
Whitney Screw Corp., Nashua, N. H.

VITAL *LIFE LINE* IN WAR PRODUCTION



POWER TRANSMISSION

As vital as any production tool, the transmission of power directly affects every branch of war production. On it, to a good degree, depends the speed, accuracy and quality of every machine.

Poorly installed, inefficient drives can easily be a drag on machine production and a source of endless power waste through slippage, friction, creep and chatter. Protect this vital life line with Morse Silent and Roller Chain Drives. No slip, no power waste—these smooth-running, compact drives transmit total power at constant high efficiency for years on end. They always maintain the correct speed ratios . . . reduce bearing wear and are unaffected by atmospheric conditions, overloads and shocks. There is practically no maintenance factor.

Whether your drive requirements be conventional or unusual, there is a Morse Silent or Roller Chain Drive in single and multiple widths to fulfill your exact demands. Sizes from fractional to 5000 horsepower. Morse Representatives everywhere are ready to help increase your productive out-put — engineer chain drives to the job.

SILENT CHAINS ROLLER CHAINS FLEXIBLE COUPLINGS CLUTCHES

MORSE *positive* DRIVES

MORSE CHAIN COMPANY ITHACA N. Y. DIVISION BORG-WARNER CORP.

Accurate, Speedy and Economical thread cutting

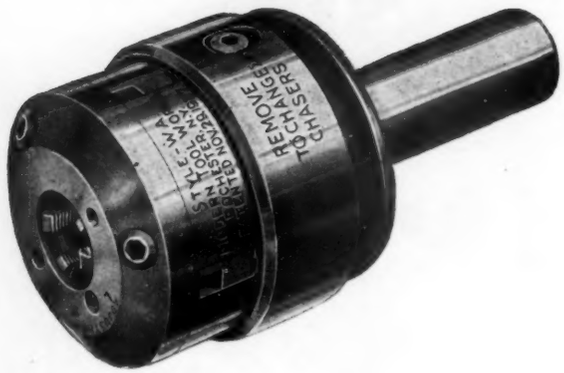
with

MODERN ROTARY TYPE SELF-OPENING DIE HEADS

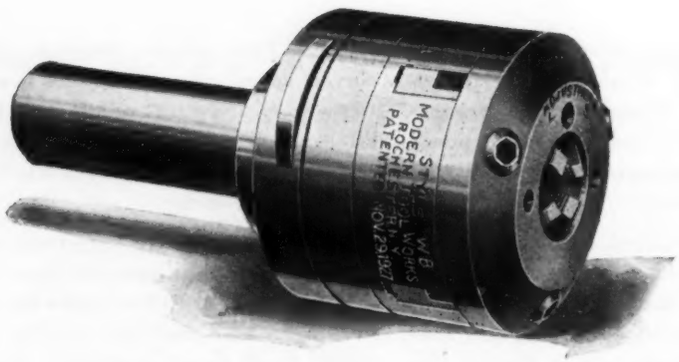
Least number of parts.

Simplest construction.

Hardened and ground throughout.



"WA" Die Head—Ring type, for opening and closing



"WB" Die Head—Trigger Trip Type

Cuts close to shoulder threads without special chasers.

Easily adjusted for Thread size.

Requires no springs to operate movement of chasers.

Made in four sizes having capacity:
Straight Threads from 1/8" to 1 1/4"
Straight or Taper Pipe Threads from 1/8" to 3/4"

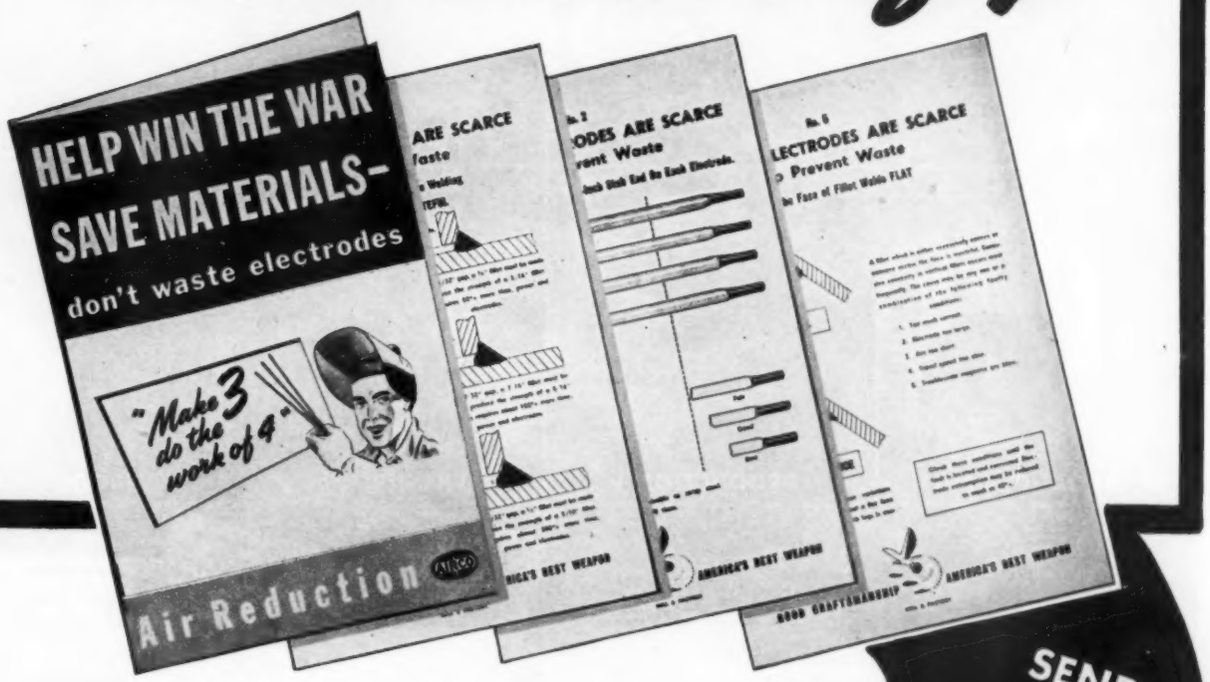
MODERN TOOL WORKS

Division of Consolidated Machine Tool Corporation

ROCHESTER, NEW YORK

NEW SHOP BULLETINS

tell how 3 Electrodes can do the work of 4



Help your welding operators get the most out of every available electrode by eliminating all possible waste — that's the job that this new folder of shop bulletins will help accomplish. The folder contains a series of six posters, each stressing a waste eliminating "do" or "don't". *Clip the coupon today—and be sure to indicate how many copies you can profitably use.*

SEND FOR YOUR COPIES *Today!*

AIR REDUCTION

AIRCO

60 EAST 42nd STREET, NEW YORK, N. Y.

In Texas: Magnolia-Airco Gas Products Co.

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Please send my free copies of your electrode waste bulletins "Help Win the War—Save Materials—don't waste electrodes."

Check number of copies desired. ☐

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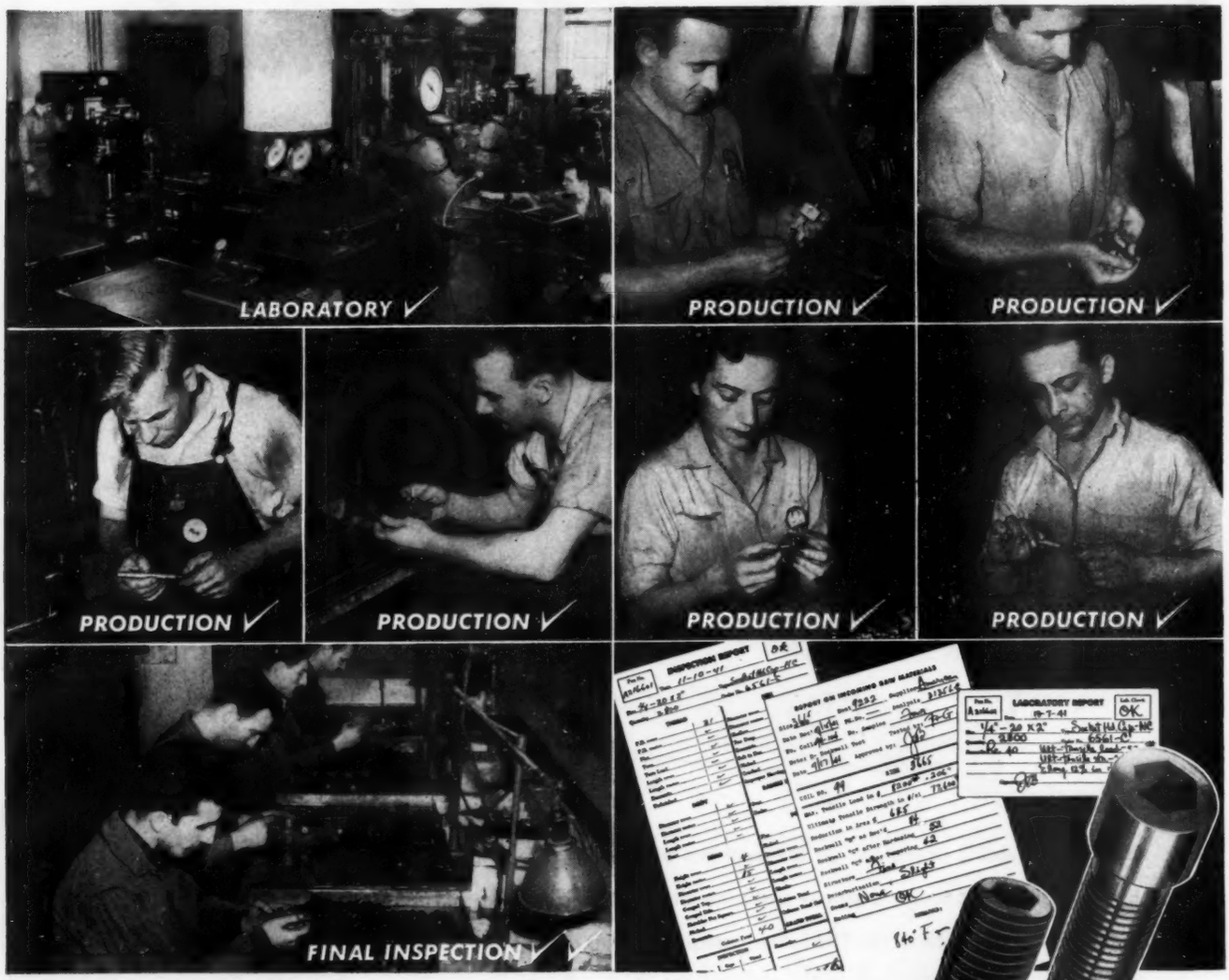
IDLE CYLINDERS ARE PRODUCTION SLACKERS: KEEP 'EM ROLLING FOR VICTORY!

Checked and Rechecked

To Insure Time-saving Performance!



Parker-Kalon Socket Screws undergo a rigid check-up routine that can only result in time-saving performance

A Quality-Control routine – without counterpart in the screw industry – weeds out screws that fail to meet the high standards of quality established by Parker-Kalon. This check-routine begins with careful analysis of the raw material and follows through to the final manufacturing operation. It gives Parker-Kalon Socket Screws a degree of dependability that helps to make every working hour count in scores of war production plants, yet it costs no more to specify *Parker-Kalon!* Parker-Kalon Corp., 194-196 Varick Street, New York, N. Y.

Quality-Controlled

Complete test and inspection routine covers: Chemical Analysis; Tensile and Torsional Strength; Ductility; Shock Resistance under Tension and Shear; Hardness; Head diameter, height and concentricity; Socket shape, size, depth, and centricality; Thread fit. Every detail is double-checked to assure the highest degree of workability.

PARKER-KALON

Quality-Controlled

SOCKET SCREWS

Give the Green Light to War Assemblies

Home to Roost

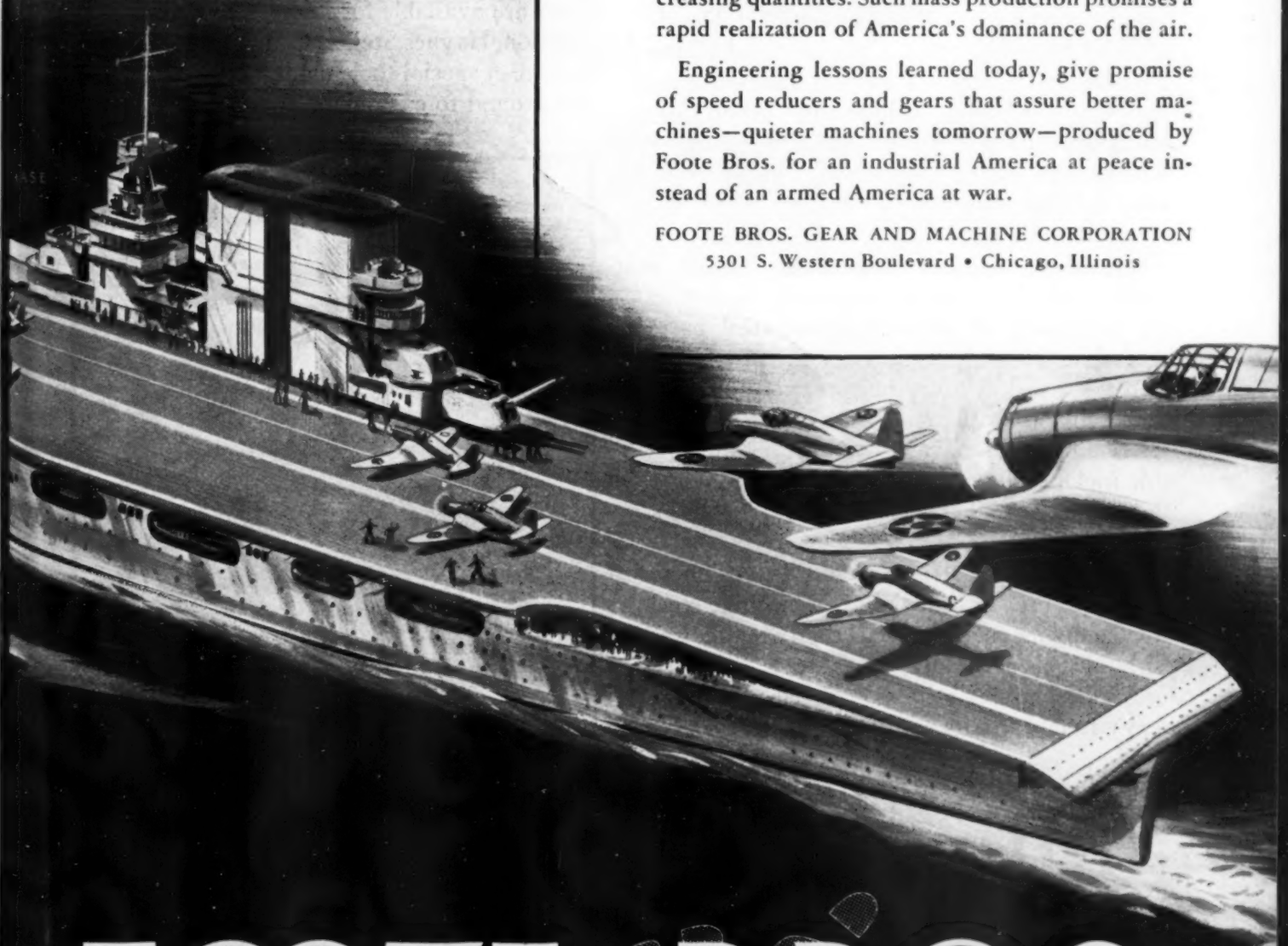
HOME TO ROOST, these eagles of the fleet return from their exploits of daring. In a voice a billion horsepower strong, the story they tell of American industrial might is ringing in the ears of Axis powers from Honshu to Hamburg.

That such an intricate mechanism as the engines that power these war eagles can be mass-produced is a tribute to the mechanical genius of American industry.

To transmit the thousands of horsepower that modern aircraft engines develop, gears must be finished to an accuracy that only a few months ago was considered a laboratory ideal. Yet today, thanks to new manufacturing techniques, these gears are rolling off production lines at Foote Bros. plant in ever increasing quantities. Such mass production promises a rapid realization of America's dominance of the air.

Engineering lessons learned today, give promise of speed reducers and gears that assure better machines—quieter machines tomorrow—produced by Foote Bros. for an industrial America at peace instead of an armed America at war.

FOOTE BROS. GEAR AND MACHINE CORPORATION
5301 S. Western Boulevard • Chicago, Illinois



FOOTE BROS.

SPEED REDUCERS • GEARS • SPECIAL ASSEMBLIES

STELLITE 98M2 METAL-CUTTING TOOLS

For Machining Steel . . . Available for Immediate Deliveries . . .

Stellite 98M2 tools are made of a cobalt-chromium-tungsten alloy especially designed to increase the speed of machining steel. Developed by Haynes Stellite Company and Union Carbide and Carbon Research Laboratories, Inc., Units of Union Carbide and Carbon Corporation, this new alloy represents another achievement in the production of non-ferrous alloy cutting tools.

Tested on War Production—Stellite 98M2 tools have been thoroughly tested in the machining of many types of steel parts needed in the war program and are now being used for a wide variety of operations on such parts. Specific operations for which Stellite 98M2 alloy tools have proved especially suitable include turning, facing, boring, grooving, and forming of all types of steel.

High Rates of Metal Removal—These tools have proved that they will machine steel at even higher cutting speeds than Stellite Star J-Metal tools or Stellite "2400" tools, and with longer life between grinds. With the new tools, heavy roughing cuts can be taken with coarse feeds—and to get high rates of metal removal—yet tool life is long and economical, for this new alloy has an *unusually favorable balance of red hardness, edge strength, and toughness.*

Available Forms—Stellite 98M2 tools are furnished as standard square and rectangular tool bits and welded-tip tools. Many sizes and types are available for immediate delivery. In addition, Haynes Stellite Company is prepared to furnish special tools made of this alloy, cast and ground to customers' specifications.

Send for this new descriptive price list. It will help you select the sizes and styles of Stellite 98M2 Metal Cutting Tools you require.

STELLITE
Reg U S Pat Off

HAYNES STELLITE COMPANY

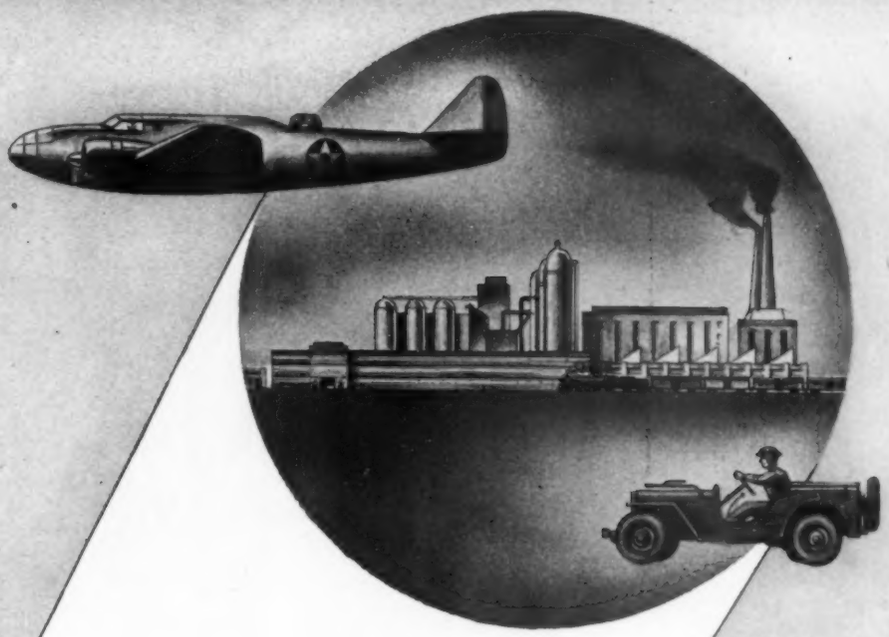
Unit of Union Carbide and Carbon Corporation

New York, N. Y. UCC Kokomo, Indiana

Chicago—Cleveland—Detroit—Houston—Los Angeles—San Francisco—Tulsa

• HIGH-PRODUCTION METAL-CUTTING TOOLS •

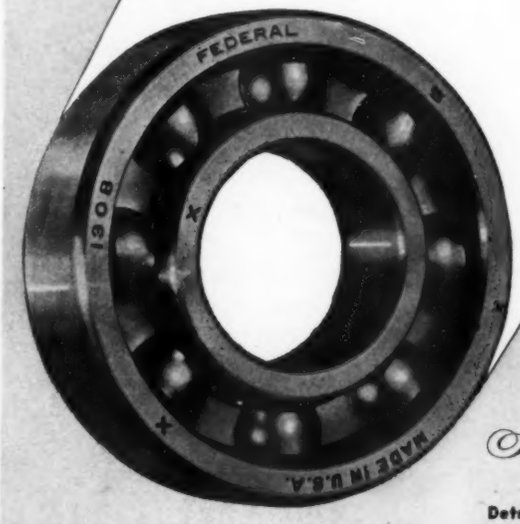
The words "Haynes Stellite," and "Stellite" are registered trade-marks of Haynes Stellite Company



TRADE MARK

FEDERAL

BEARINGS



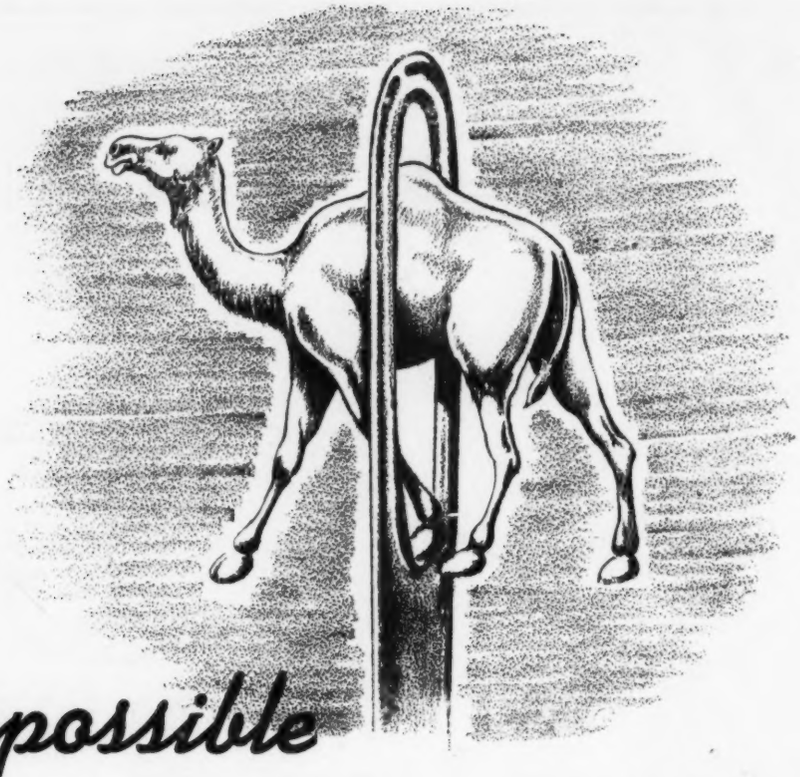
TRADE MARK

THE FEDERAL BEARINGS CO., INC.

Makers of Fine Ball Bearings

POUGHKEEPSIE, N. Y.

Detroit Office: 2640 Book Tower • Cleveland Office: 402 Swetland Building
Chicago Office: 902 S. Wabash Ave. • Los Angeles Office: 5410 Wilshire Blvd.



THE *Impossible* TAKES A LITTLE LONGER

● Yanks in Bataan made four "bombers" out of the wrecks of a dozen planes tied together with baling wire, and blasted the daylights out of the sons of the Rising Sun. In Libya, Tommies assembled parts of half a dozen burned-out trucks to make one rambling wreck that covered several hundred miles on pilfered Axis gasoline before it gave up its multi-part ghost.

Yes, when life itself is the stake, men rise above the difficult to do the impossible.

Our lives, too, are at stake now. We've got to make tools do jobs they never were intended for, to make available materials take the place of prioritied ones, to comb scrapheaps and stockrooms for discarded or decadent items that suddenly have been transmuted into pure gold. The industrial America that always spent prodigally must now out-Heap Uriah.

Your purchasing must reflect this changed way of life. Next to production, you now need efficient, all-seeing, 24-hour-a-day service on vital equipment, tools and supplies.

Buy from your local industrial distributor. He runs a business normally based on immediate service from stock. Despite present restrictions, he still is allowed to stock available items, because his stock acts as a central stores department for *all local plants*. He is set up to make the promptest possible deliveries to you.

He expects emergencies and accepts them as one way of proving his usefulness to you. He will comb the countryside to get you what you need to keep wheels turning if he doesn't have it in stock.

He is actively searching for surplus tools, supplies and materials which can be put to immediate use—he knows the inside of every local plant.

He is trying to anticipate your requirements—his preferred reply to any request is "We're sending it over right now!"

He'll help you find alternate items if the exact items you want aren't to be had anywhere.

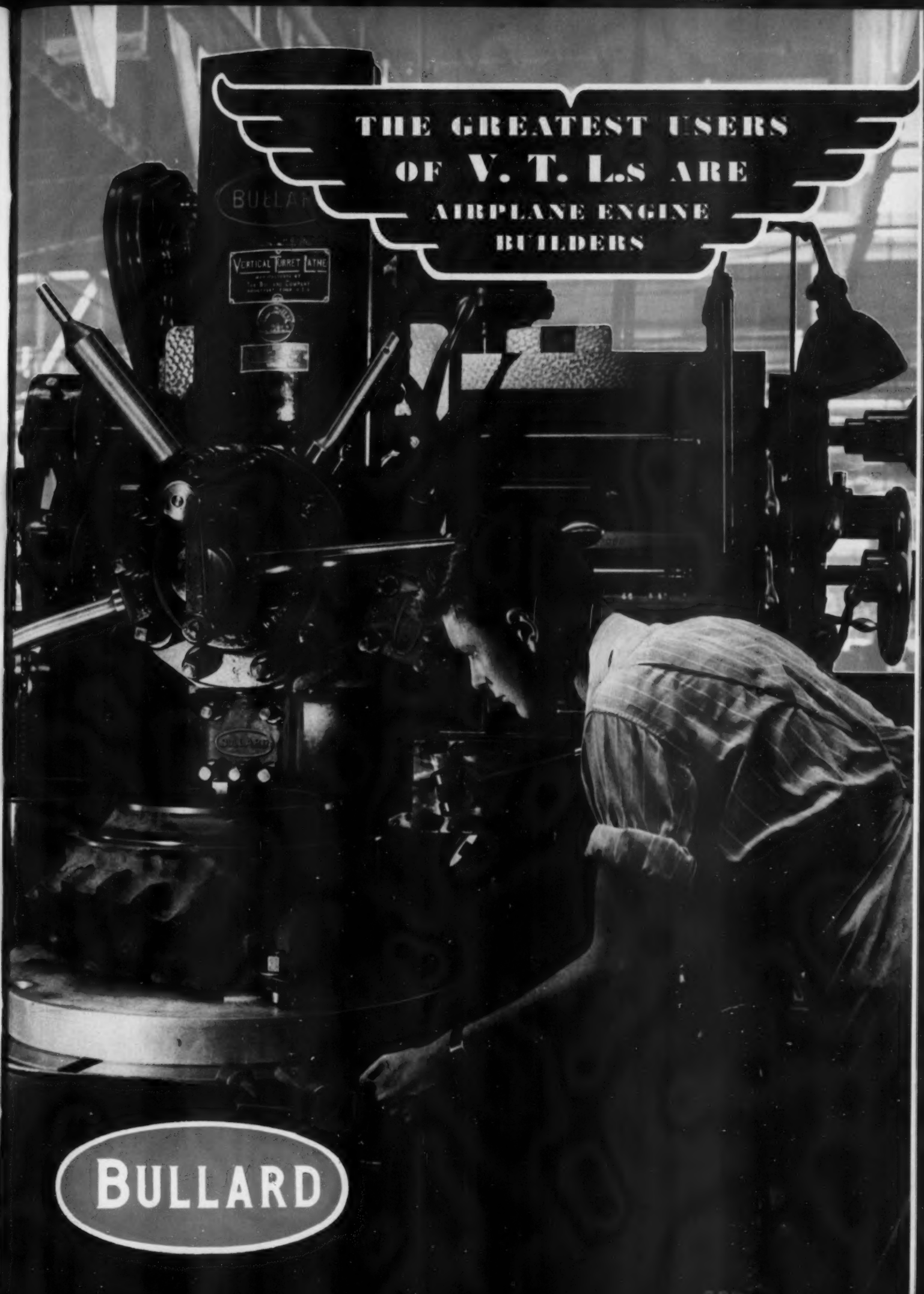
He's an expert at supplying, just as you're an expert in manufacturing.

He's the short cut between you and your requirements for tools, materials and supplies.

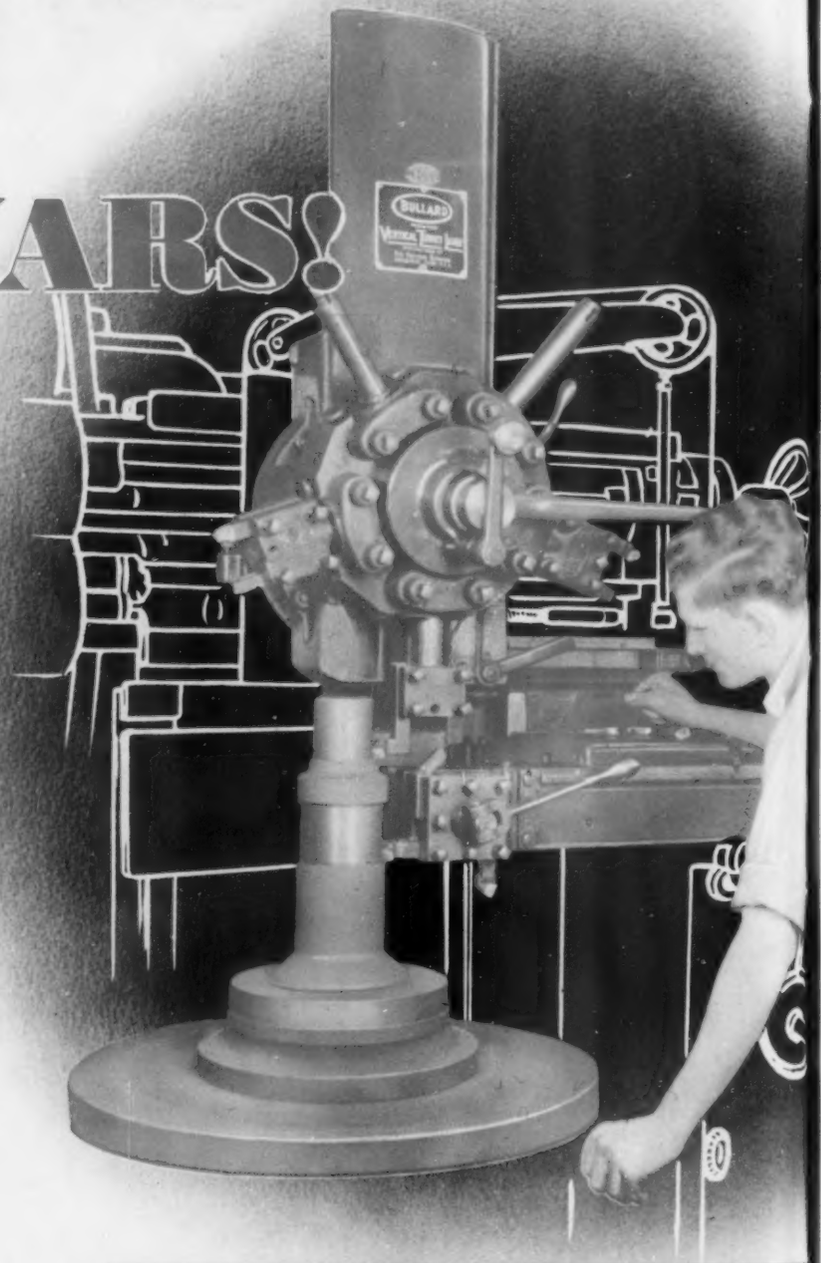
He's on the job to get more production, sooner—USE HIM!

PUBLISHED IN THE INTEREST OF THE INDUSTRIAL DISTRIBUTOR BY **Mill Supplies**

THE MAGAZINE FOR INDUSTRIAL DISTRIBUTORS AND THEIR SALESMEN


THE GREATEST USERS
OF V. T. L.s ARE
AIRPLANE ENGINE
BUILDERS
VERTICAL TURRET LATHE
BULLARD

To SAVE TIME... *that* WINS WARS!



Consider the reasons for the Bullard Vertical Turret Lathe's success—the horizontal table which makes it easier and quicker to chuck work (particularly heavy or awkward pieces)—a basic design which cuts down torque and strain—a power traversing main head and a side head cut independently *at the same time.*

Consider the *time* the V.T.L. saves on cuts and between cuts—either on production work or in the job shop! Consider Bullard's 60 years of experience which have brought this basic sound design to top efficiency and speed!

Proof? Airplane engine builders use more V.T.L.s than any other industry. They *have* to save TIME—because it helps win wars!

BULLARD V.T.L.

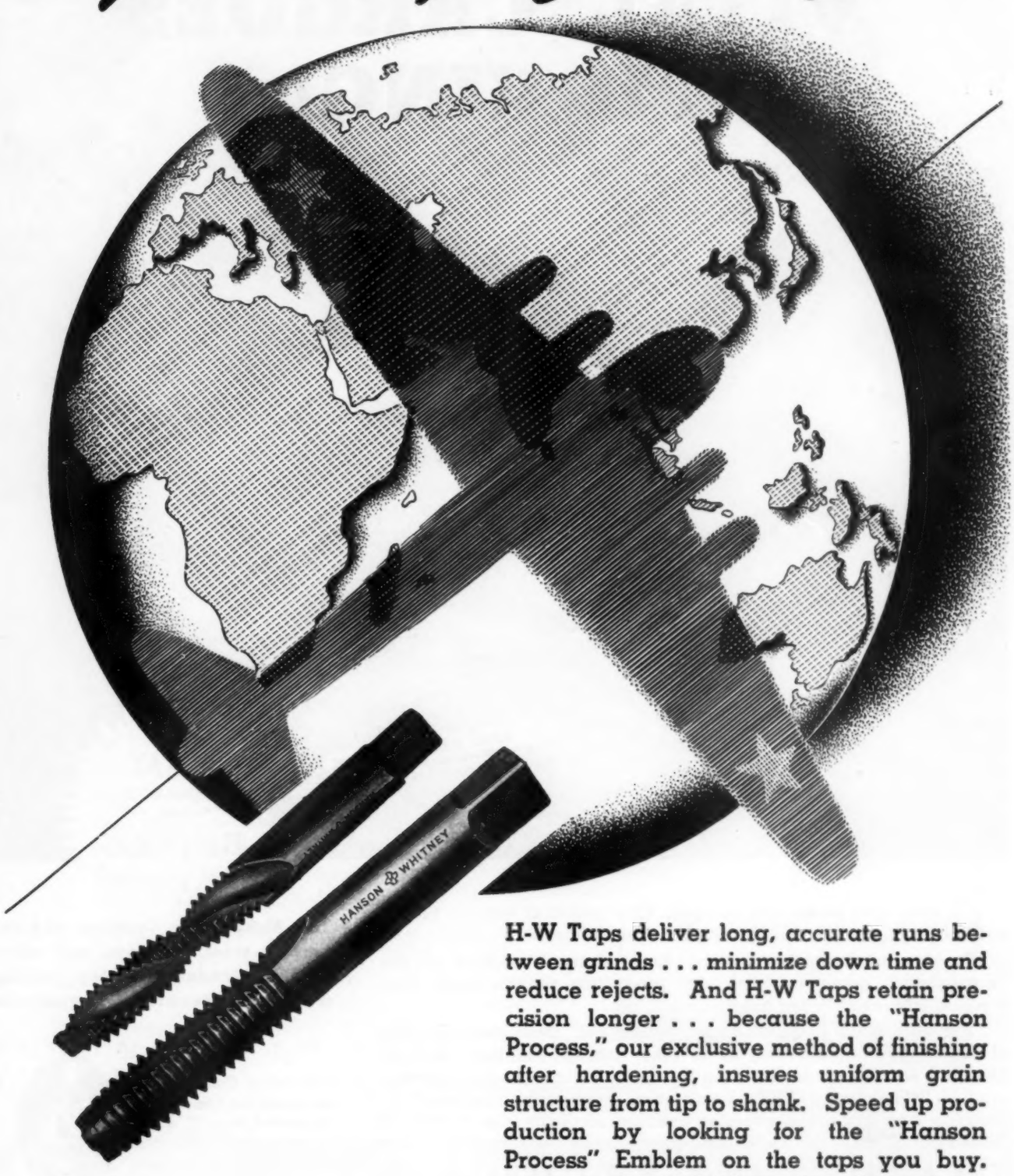
It Saves Time on Cuts and Between Cuts

Only a Bullard V.T.L. has ALL these Features

1. Vertical Design
2. 5-Face Turret on Main Head
3. 4-Tool Turret on Side Head
4. Simultaneous and Independent Head Action
5. Rapid Power Traverse of Main Head
6. Centralized Control
7. Rigidity and Power for Carbide Tools

THE BULLARD COMPANY BRIDGEPORT CONNECTICUT

Big Enough for the Job

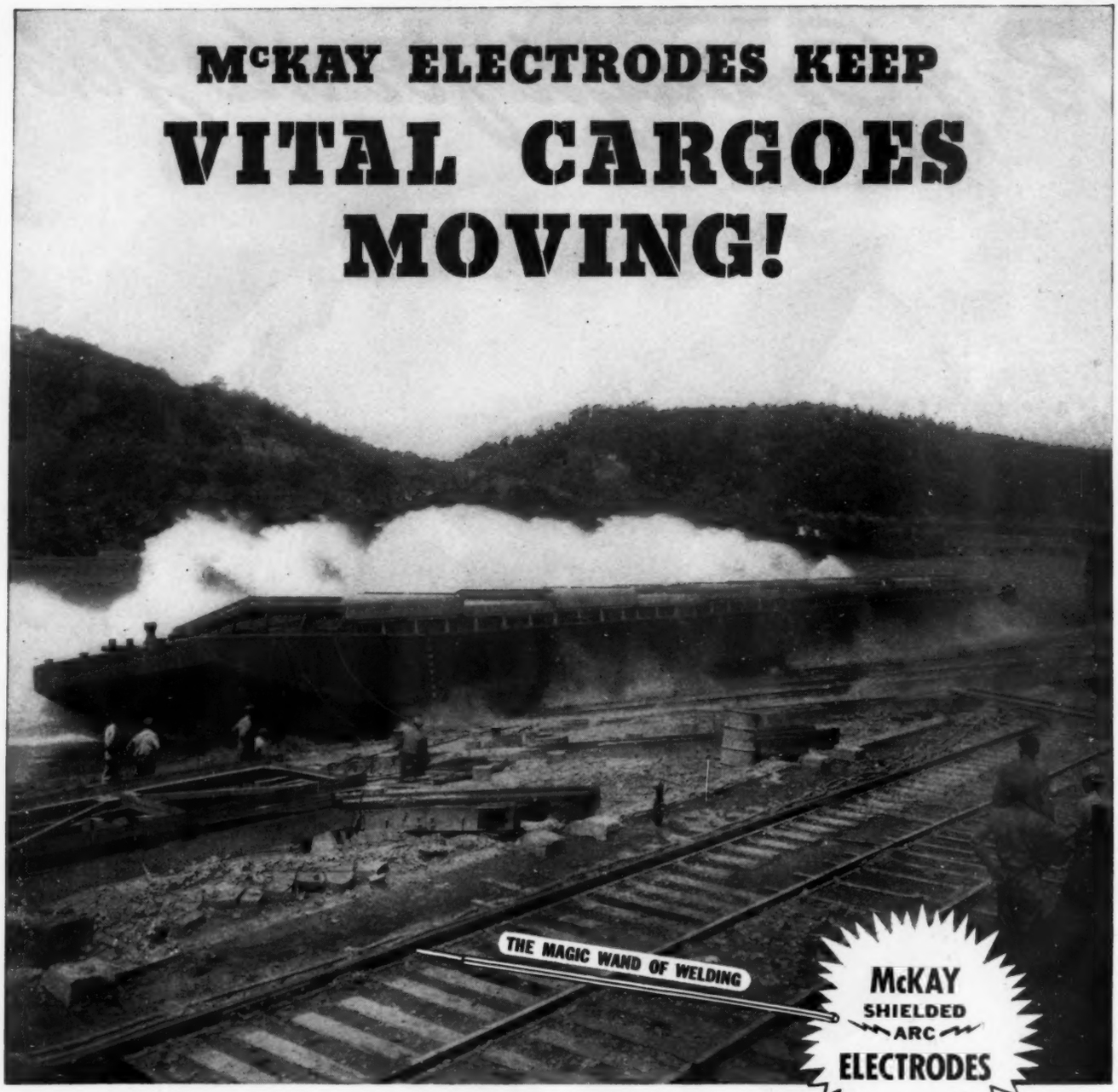


H-W Taps deliver long, accurate runs between grinds . . . minimize down time and reduce rejects. And H-W Taps retain precision longer . . . because the "Hanson Process," our exclusive method of finishing after hardening, insures uniform grain structure from tip to shank. Speed up production by looking for the "Hanson Process" Emblem on the taps you buy. For more detailed information please write.

The HANSON WHITNEY MACHINE CO

HARTFORD CONN., U.S.A.

McKAY ELECTRODES KEEP VITAL CARGOES MOVING!



Ol' man river teems with shipping for a nation at war . . . thanks to the heroic efforts of the country's barge builders.

To keep vital cargoes moving, these stalwart workers on the "home front" barely establish new production records when they *top* 'em with even better ones!

Welding plays a major role in "turning out" these steel Goliaths of the inland waters. And, as in other marine building, McKAY Shielded Arc Electrodes function flawlessly in this exacting service . . . SAVING as they SERVE. *Saving* time, man-power, vital steel . . . *Serving better* through superior qualities resulting from McKAY'S "researched" manufacture and rigidly controlled production.

THE McKAY COMPANY · PITTSBURGH, PA.

PACIFIC COAST SALES OFFICES: 125 S. Santa Fe Ave., Los Angeles · 100 Howard St., San Francisco

The McKay line includes regular carbon steel, stainless, and alloy steel electrodes for every welding purpose. Literature on request.

★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★

★ The McKay Company was among the first honored with the coveted Navy "E" award for excellence in fulfilling Naval Ordnance contracts. ★

★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★

McKAY WELDING ELECTRODES

AND INDUSTRIAL, MARINE AND AUTOMOTIVE CHAINS

BOUT of the O'TOOLS

AIR vs. HIGH CYCLE GRINDERS
TIME-OUT for TUNE-UP

"Here's OIL for the LAMPS OF JAPAN"

The Rotor Analyst and his cohorts, AIR and HIGH-CYCLE O'Tool recommend this formula for "taking care" of the Axis:

Take care of your AIR and HIGH-CYCLE tools to *keep 'em running!* . . . AIR tools, for example:

Oil and grease them properly, regularly.
Eliminate moisture from air lines.
Keep air strainer, blades, and governor "in the pink."
Start new tools properly.
Know what to do when tools lose power.
Observe portable tool Safety Rules.

To help you *keep 'em running,* we have published a booklet giving maintenance pointers for AIR grinders, drills, etc. Applicable also to *other makes of tools.* The same information, in condensed form, is available in an attractive wall chart for handy reference in the shop. Call the Rotor Analyst or write us for your free copies today.

This attractive wall chart, 18" x 24" gives maintenance tips for Air tools. More detailed information in booklet form. Both free on request. Similar guides also are available for High-Cycle Tools.

AIR

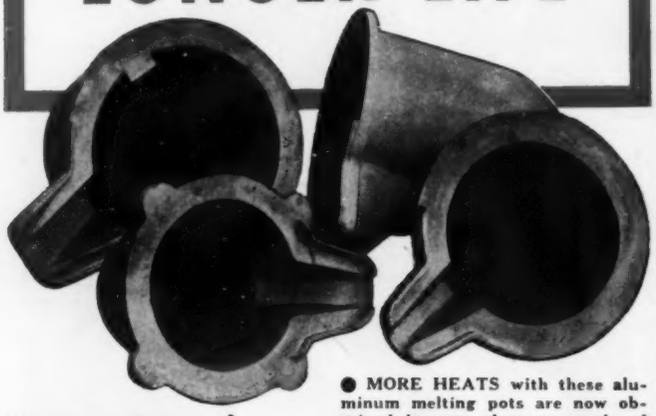
THE ROTOR TOOL CO.

CLEVELAND, OHIO

HIGH CYCLE

UNBIASED ANALYSIS OF PORTABLE TOOL PROBLEMS

ABSCO MEEHANITE Melting Pots Give LONGER LIFE



● MORE HEATS with these aluminum melting pots are now obtained because they are made of ABSCO Meehanite. Capacities are available up to 2,000 lbs.

You are Assured More Heats with

ABSCO MEEHANITE Melting Pots for These Reasons:

1. Special molding methods developed in our foundries result in longer pot life.
2. With the positive technical control of physical characteristics of the metal, made possible with Meehanite, pots of predetermined heat resistant qualities are cast.

Write for a Meehanite Specification Wheel Chart and full information on Meehanite for Heat-Resisting, Wear-Resisting, Corrosion-Resisting or General Engineering purposes.

Bring us your problems

THE AMERICAN BRAKE SHOE AND FOUNDRY COMPANY

BRAKE SHOE AND CASTINGS DIVISION

FOUNDRY
MAHWAH
NEW JERSEY

OFFICES
230 Park Avenue, New York, N. Y.
332 South Michigan Ave., Chicago, Ill.

Specialized Industrial CHEMICAL COMPOUNDS

TURCO AIRLION NO. 81

CLEANS ALUMINUM and other metal parts by hot-tank immersion. Has potent alkaline reaction, but will not attack aluminum. Acts by wetting out but is soapless. Maximum alkalinity with safety.

Write for Turco Bulletin No. A-654-18.

TURCO KOLDWELD

ETCHES ALUMINUM preparatory to spot-welding. Requires only a two-minute cold dip and a quick clear water rinse. Fast and easy to handle. Write for Turco Bulletin No. A-221-18.

TURCO SLIP

REMOVES ZINC CHROMATE PRIMER by immersion. Works quickly. Will not attack aluminum. Completely safe. No fire hazard. Nontoxic. Write for Turco Bulletin No. A-657-18.

Turco Products, Inc., manufactures a complete line of Specialized Industrial Chemical Compounds for every operation in your plant. Write us, or phone your local Turco Service Specialists for the proper answer to your problems which involve surface cleaning or processing preparatory to manufacturing operations, or plant maintenance.

TURCO PRODUCTS, INC.

LOS ANGELES • SAN FRANCISCO • CHICAGO

HEAD OFFICE: 6135 South Central Avenue, Los Angeles

Sales and Service Representatives and Warehouse Stocks in All Principal Cities

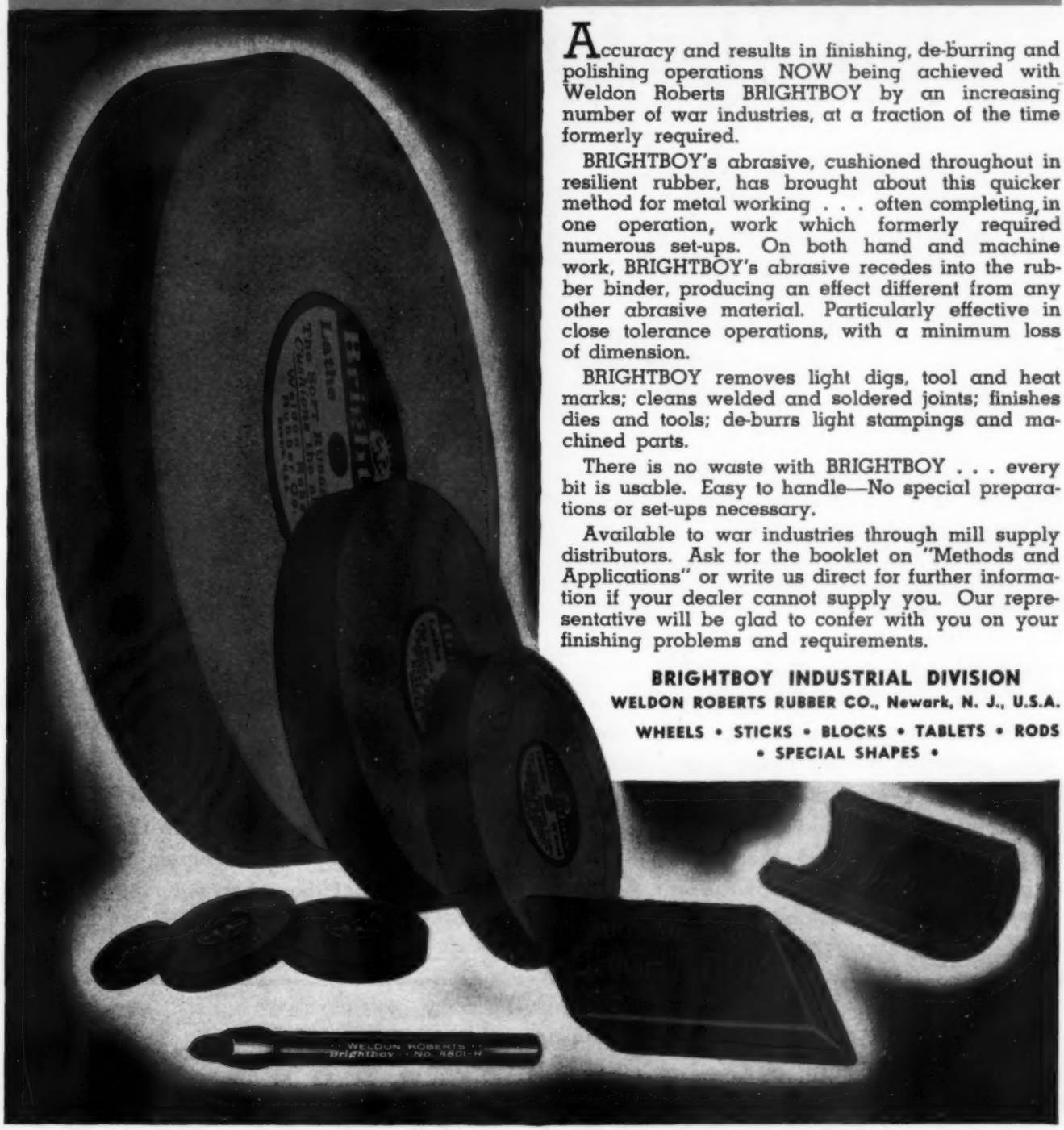
SPEED-UP FOR WAR PRODUCTION

For Better FINISHING, DE-BURRING POLISHING—*in a fraction of the time*...

WELDON ROBERTS

Brightboy

"The *Soft Rubber Binder* Cushions *the Abrasive*" REG. U.S. PAT. OFF.



Accuracy and results in finishing, de-burring and polishing operations NOW being achieved with Weldon Roberts BRIGHTBOY by an increasing number of war industries, at a fraction of the time formerly required.

BRIGHTBOY's abrasive, cushioned throughout in resilient rubber, has brought about this quicker method for metal working . . . often completing, in one operation, work which formerly required numerous set-ups. On both hand and machine work, BRIGHTBOY's abrasive recedes into the rubber binder, producing an effect different from any other abrasive material. Particularly effective in close tolerance operations, with a minimum loss of dimension.

BRIGHTBOY removes light digs, tool and heat marks; cleans welded and soldered joints; finishes dies and tools; de-burrs light stampings and machined parts.

There is no waste with BRIGHTBOY . . . every bit is usable. Easy to handle—No special preparations or set-ups necessary.

Available to war industries through mill supply distributors. Ask for the booklet on "Methods and Applications" or write us direct for further information if your dealer cannot supply you. Our representative will be glad to confer with you on your finishing problems and requirements.

BRIGHTBOY INDUSTRIAL DIVISION
WELDON ROBERTS RUBBER CO., Newark, N. J., U.S.A.

WHEELS • STICKS • BLOCKS • TABLETS • RODS • SPECIAL SHAPES •

Shall War Plants Shut Down?
Shall Men be Laid Off?
Shall Our Soldiers Die?

—ALL BECAUSE YOU DIDN'T SALVAGE ALL YOUR SCRAP IRON AND STEEL?

Unless the steel industry gets 6,000,000 *EXTRA* tons of scrap iron and steel this year, it cannot produce *all* the steel required for our war production program.

It's a serious situation. Because about half of the steel in every tank, airplane, ship, gun and shell comes from scrap—approximately 50% of every charge into an open-hearth or electric furnace is scrap.

There's a lot of scrap iron or steel in or around every plant or shop. Old, obsolete, idle machines—old line shafting and pulleys—broken or worn-out dies, jigs, templates, rolls, patterns, molds, tools, gears, cams, fixtures, trucks—old pipe, valves, radiators—idle water tanks and supports—unused smoke stacks and other structural items—anything made of iron or steel which has lost its value in its present form. Don't overlook the scrap at home, too.

Dig it out. It's *urgently* needed—to keep war production flowing—to keep men at work—to protect our soldiers against the enemy.

Put a competent man or a committee to work on a special campaign of your own. Tell *every* man in your plant how important scrap is today. Post this story on your bulletin board, (we'll gladly send reprints). Pile up every piece—no matter how small. You'll be surprised at the amount you find. Then call your nearest junk or scrap dealer. He'll buy it from you—and send it on its way to a steel mill.

If you and every plant does this *PROMPTLY*, you'll be helping to hasten the end of the war—you'll be helping to save the lives of those who fight for you.

REPUBLIC STEEL
PRODUCTION FOR VICTORY

This Advertisement Sponsored by

REPUBLIC STEEL CORPORATION

General Offices: Cleveland, Ohio

Berger Manufacturing Division • Culvert Division • Niles Steel Products Division • Steel and Tubes Division
Union Drawn Steel Division • Truscon Steel Company • Export Department: Chrysler Building, New York, New York

In Cooperation with the U. S. Government's Salvage Campaign

TASK FORCES *BEHIND* TASK FORCES

Somewhere, tonight, the Navy has a task force in action.

In thousands of plants, tonight, Industry has task forces in action too.

This one, operating at VARD, is engaged with America's greatest adversary—*time*. Like the Navy forces, it is alert, determined—and moves with precision. It knows it is in a war.

Other task forces at VARD—in research and in production—are also working against time; also in the war.

Their task is to design, build, and deliver on schedule the many precision-made VARD products used on Navy ships, Navy planes, and in hundreds of plants from coast to coast making Navy parts and equipment.

VARD INC. PASADENA, CALIFORNIA

SUCCESSOR TO VARD MECHANICAL LABORATORY

PREVENT CONTAMINATION – EXTEND TOOL LIFE

with the NEW BARRETT COMBINATION STERILIZER AND SEDIMENTOR for CUTTING OILS . . . .

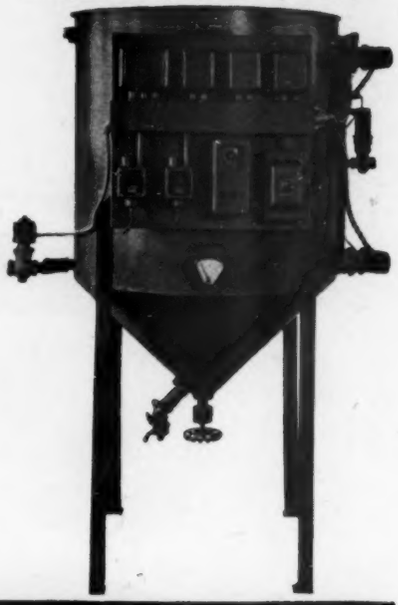
Protect your operators against infection—insure more and better work from your cutting tools—by sterilizing your cutting oils and precipitating sediment *at the same time.*

The NEW BARRETT STERILIZER AND PRECIPITATOR combines these two operations in one piece of apparatus which can be depended on to handle both operations effectively, efficiently and economically. Sterilization is by heat and is a positive active operation in the line ahead of the supply tank. By locating in this position, contamination is intercepted before the cutting oil is conditioned for safe, bacteria-free reuse.

Because of the heat to which the oil is subjected during sterilization, the viscosity of the cutting oil is reduced, thereby encouraging precipitation of minute heavy particles. The sediment thus liberated settles out and drops by gravity to the bottom of the sterilizer where provision is made to scrape the precipitated solids from the conical bottom and clean them out.

By thoroughly and constantly sterilizing and effectively removing solid matter, the Barrett Combination Sterilizer and Sedimentor reconditions cutting oil for reuse; sterilized for safety's sake and abrasive-free for longer tool life.

Barrett Sterilizer and Sediment Precipitator arranged for fully automatic operation.

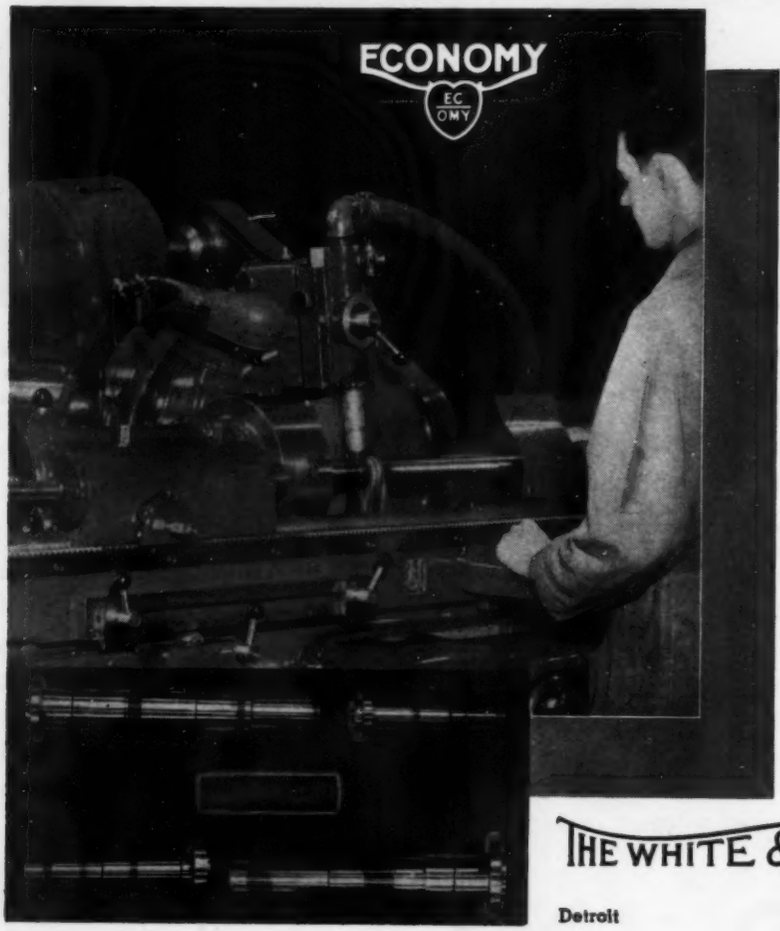


GET COMPLETE INFORMATION NOW

These units are available for floor, wall and post mounting and are furnished with manual semi-automatic or full automatic control as required. Send at once for detailed information on this timely Barrett development.

THE LEON J. BARRETT CO., WORCESTER, MASS.

Designers and Builders of Centrifugal Machinery



This Jones & Lamson Automatic Thread Grinder using ECONOMY GRINDING OIL cuts carbon electrode threads from the solid in one cut in approximately five minutes. Before ECONOMY GRINDING OILS were introduced, it took a full day to cut this coarse pitch acme thread with high speed tools (part in center, lower left).

The combination of ECONOMY GRINDING OILS, the correct wheel, and the modern designed grinder are of equal importance in producing accurate threads from the solid at a production rate never before thought possible.

Five Minutes Now, Formerly a Day

New catalog E-18 well worth having. Yours for the asking.

THE WHITE & BAGLEY COMPANY

Worcester, Mass.

Detroit **Minneapolis**

HOW TO GET TOOLS THAT LAST LONGER!

AN EXTRA MINUTE WHEN YOU ORDER CAN MEAN EXTRA HOURS OF PRODUCTION

The conservation of tools is an all-important phase of our war effort. Every tool must do more, do it faster—and *last longer!*

To accomplish these things, each tool must be engineered and produced to fit the specific job it is to do. Your tool maker can produce a more efficient, longer lasting tool if he is given *full information* concerning the job.

When writing your orders, take an extra minute to add some helpful data. Tell your tool manufacturer all you can about the job—explain the cutting conditions, state the tolerances and, whenever possible, enclose a print of the part showing the surfaces to be machined. This information will help your tool maker do his job better and will help you get tools that do more and last longer!

ILLINITE

High Speed Production Tools

Hobs • Broaches • Shaper Cutters
Milling Cutters
Ground Form Tools • Special Tools

★ ★ ★

Gear Measuring Machines
Gear Measuring Blocks
Die Filing Machines

ILLINOIS TOOL WORKS

MANUFACTURERS OF METAL CUTTING TOOLS AND SHAKEPROOF PRODUCTS

2501 N. Keeler Avenue, Chicago, Illinois

In Canada: Canada Illinois Tools, Ltd., Toronto, Ont.

The hand that rules the paper rocks the world

A SILENT, terribly significant battle is being fought, about which we hear and see very little.

It is the battle of Design.

It can win, or lose, the war, because all production, all transportation, all mechanized and explosive conflict depend upon it.

"Design Engineer" is the modern name for the scientific descendants of men like Eli Whitney and Cyrus McCormick. America probably has more highly trained Design Engineers than the rest of the world combined.

▶ The enduring confidence in final victory, which survives even the worst battle news, is based upon the knowledge that America excels in inventive skill.

But U. S. Design Engineers had a late start. Enemy draughting boards were plotting today's battle machines while ours were blithely inventing and improving the thousands of mechanical aids for work and play which characterize American life.

Lost time is being made up. Research and design on weapons and machines which took years in enemy countries are compressed into weeks by sheer force of numbers of skilled minds, patriotically working without regard to hours or fatigue.

The men who put on paper the intricate mechanisms of our continuous strip steel mills, harvesting combines, gang drills and juke boxes are learning the science of war designing.

They are learning it the hard way, as all citizens of peace-minded democracies must. But we have new factories, new production machines, new ship construction methods, new tanks, bombers and thousands of other processes and devices to prove they are doing their job well.

▶ Because American Industry had built up its great staff of mechanical engineers; because no other nation can match our skill in design engineering, the United States is winning the silent battle of Design.

But designs must be improved constantly. It is estimated that at least 12,000 members of this army of engineers are at work on improvements in military planes alone.

Into a recent improvement of an American tank went 900 pounds of blueprints, representing the work of a segment of this army of brains. Each day brings these more potent weapons closer.

Design Engineers are responsible for new planes of plywood and of steel.

To save brass and copper, some of these Design Engineers developed new uses for plastics.

▶ 700 million additional pounds of magnesium were needed, so some of them designed equipment to get it from plain seawater. The plants are at work.

Because of a new method of producing more powerful gasoline, Design Engineers were able to start plans for an airplane engine of 3,000 h.p. Engines up to 2,000 h.p. are already in production.

Design Engineers took the hand-fitted, laboriously-built Rolls Royce aviation engine and worked out machines and methods to produce it to closer tolerances and in amazing quantities.

Tens of thousands of instances of paper-work that will save American lives and win future battles could be given.

The Design Engineer is the product of the American Industrial System. He is available in war, because his skill was fostered and developed in peace, out of the ploughed-back profits of business.

* * *

In recognition of the miracle of war production—accomplished through the cooperation of American management and labor with the W. P. B. . . . this advertisement is published by the McGraw-Hill Network of Industrial Communications.

McGRAW-HILL PUBLISHING COMPANY, Inc.

330 WEST 42ND STREET . . NEW YORK

When You See ⬅ This in the Newspapers Remember This ⬇

AMERICAN Business Management can work miracles of war production because American business has evolved methods through which the sum of genius can be greater than the sum of its parts.

If individual brilliance alone were the secret, airplanes would have soared over the Acropolis of Ancient Greece. There have always been bright minds.

▶ Industrial progress started when men began to share their ideas—when the inter-change of experience replaced the old habit of hoarding techniques.

In America, methods of interchanging ideas between all production men had reached a high degree of perfection long before war placed its gigantic challenge.

Thousands of conventions, industrial clinics, plant visitation groups, patent pools and other means of swapping ideas were in constant use.

Underlying and supporting this continuous trading of "know-how" was the Industrial Press developed in America to a far greater degree than anywhere else on earth.

Design Engineers, like everybody else in United States production, depend upon Industrial Magazines to keep them from wasting time on problems that somebody else has already solved.

For this reason, every Design Engineer starts each day's work with the advantage of the accumulated experience of a whole nation. He does better work that way.

It's important for every key man in your organization to have his own copy of each industrial magazine that can help him do a better job. The few dollars saved in routing single copies around the plant may be robbing your men of valuable experience records.

For impartial and experienced help in surveying your actual needs in Industrial Magazine subscriptions write to the Reading Counsellor, McGraw-Hill Publishing Company.

★ ★ ★

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More than 1,000,000 of the executives, designers and production men who give America her world supremacy in technical "know-how," use the editorial and advertising content of the 23 McGraw-Hill publications as a means of exchanging ideas.

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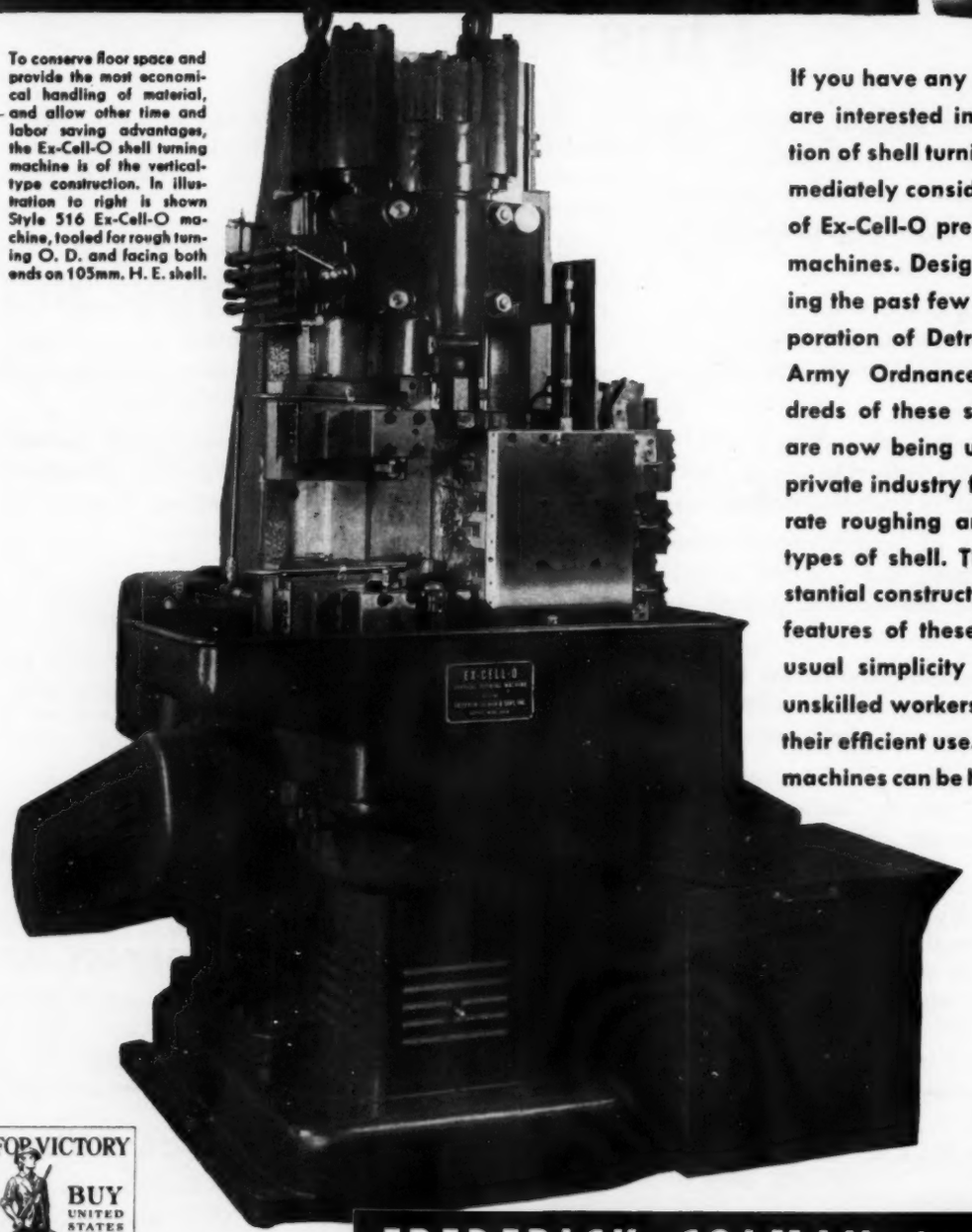
FOR *Fastest* SHELL TURNING

EX-CELL-O PRECISION MACHINES FOR ACCURATE AND SPEEDY PRODUCTION . . . ROUGHING AND FINISHING . . . 75 TO 155MM. SHELL

These Ex-Cell-O machines, which are constructed specifically with feeds and speeds for the most efficient use of cemented carbide tools, are being tooled for either rough turning and facing or finish turning all sizes and styles of shell . . . from 75mm. to 155mm.

To conserve floor space and provide the most economical handling of material, and allow other time and labor saving advantages, the Ex-Cell-O shell turning machine is of the vertical-type construction. In illustration to right is shown Style 516 Ex-Cell-O machine, tooled for rough turning O. D. and facing both ends on 105mm. H. E. shell.



If you have any shell turning problem, or are interested in the most rapid production of shell turning work, you should immediately consider the many advantages of Ex-Cell-O precision-built shell turning machines. Designed and developed during the past few years by Ex-Cell-O Corporation of Detroit, in cooperation with Army Ordnance representatives, hundreds of these single-purpose machines are now being used in government and private industry for the speedy and accurate roughing and finishing of various types of shell. The general design, substantial construction, and semi-automatic features of these machines provide unusual simplicity in operation, allowing unskilled workers to be trained quickly in their efficient use. In many instances, two machines can be handled by one operator.

For construction details, actual production figures, and early delivery dates, wire or phone *today* to Frederick Colman & Sons, Inc., Detroit, Michigan (Telephone TYler 4-3207).

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War equipment cannot be "babied". Every part must stand up under tough service. The wear resistance of the extremely hard surfaces obtainable with Nitralloy Steels protects vital parts. We are manufacturing Nitralloy Steels for every type of fighting equipment.

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"THE WILL TO MAKE GOOD STEELS"

TORQUE
WELCO
MOTORS

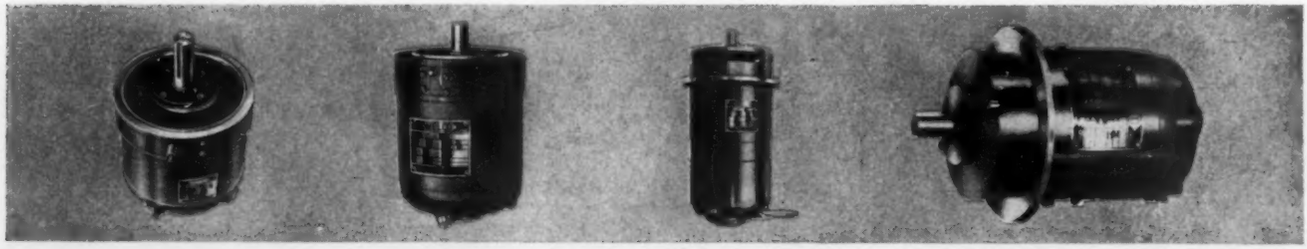
THERE'S A LESSON HERE ON CHOOSING MOTORS...

If all misfit motor applications were perfectly obvious the instant the juice is turned on, they could be quickly replaced. But it's not that easy. Power systems have varying degrees of square pegs in round holes.

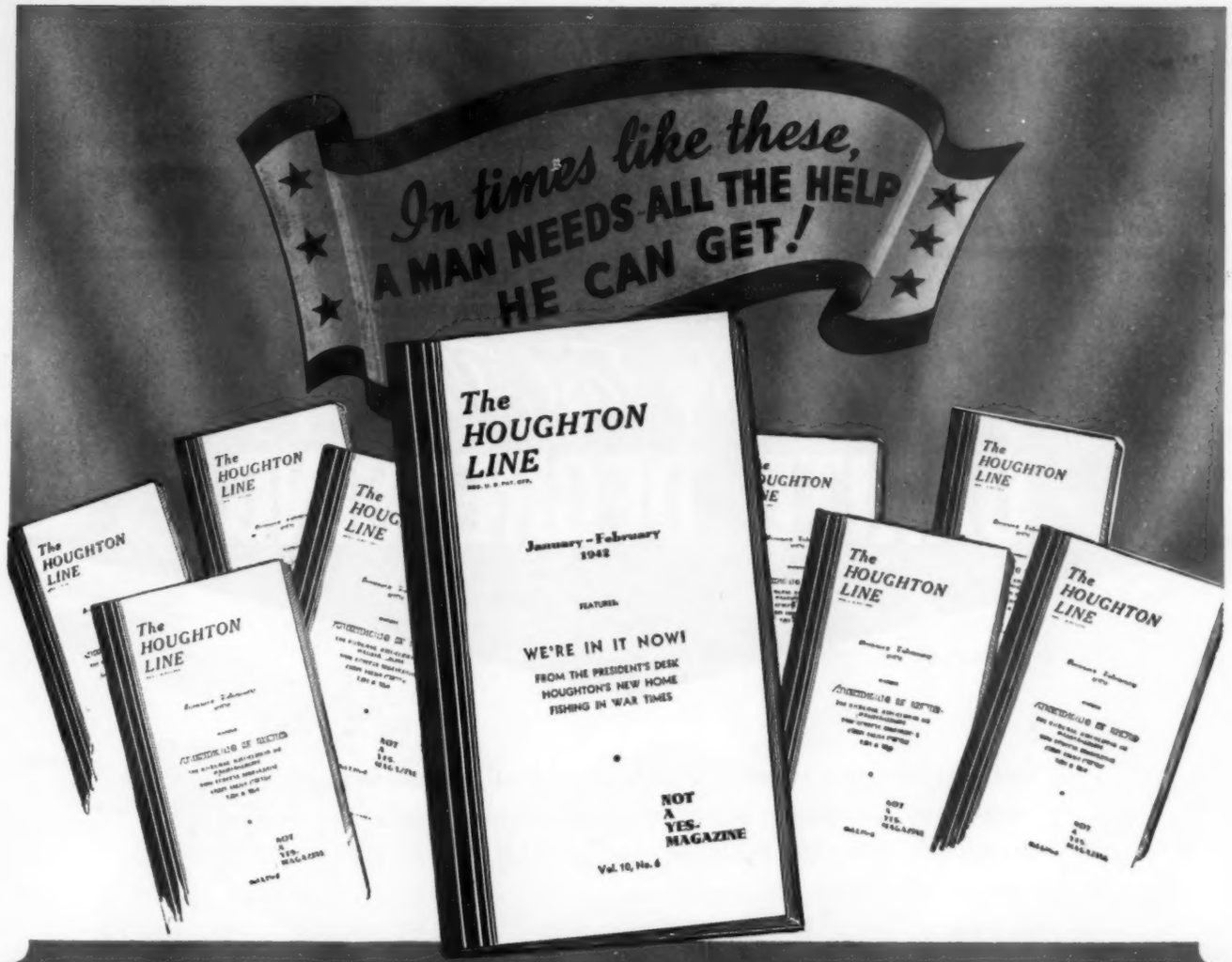
The wrong motor may do a certain job well enough to *get by* for many months. But when both quantity and quality production are so important—when every reject is a catastrophe—when power failure means hours of delay, just getting by won't do.

Many precision operations work at peak efficiency only under exact torque, hair-fine speed control, unusual mounting position, wide ratio of size to power or some other combination of features available only in a custom built torque motor.

Where the power job is simple, by all means standardize. When there are complications, a custom built Welco Torque Motor is the key to uninterrupted and trouble-free operation.



The B. A. WESCHE ELECTRIC CO., 1626 Vine St., Cincinnati, Ohio



CAN *YOU* USE AN EXTRA 77 YEARS OF EXPERIENCE?

As industry changes over from peace-time to war production, plant men face many new problems — machining new steels or new metals . . . cleaning, heat treating, quenching, preventing rust, special lubrication. These problems are covered regularly in the "Houghton Line," which for 34 years has been sent to industrial plant executives the world over.

We believe we can contribute materially in the present emergency, not only with products and service along these lines, but also by increasing the circulation of the LINE to cover more men who have been stepped up to new and unfamiliar responsibilities. If you do not now receive the LINE and would like to enjoy its frank business comment as well as its practical processing articles, sign and mail the coupon below.

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Effective, fast-working Oakite materials, specially designed for preparing surfaces for BLACK FINISHES on war supply items, will give you the satisfactory results you want, help you keep production moving smoothly . . . and do it on a low-cost basis.

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If you are making gun or airplane parts, automotive parts, instruments, bearings, gears, tools or other war products and are having trouble in applying BLACK FINISHES, let us give you the benefit of our experience in this work. Write today . . . no obligation.

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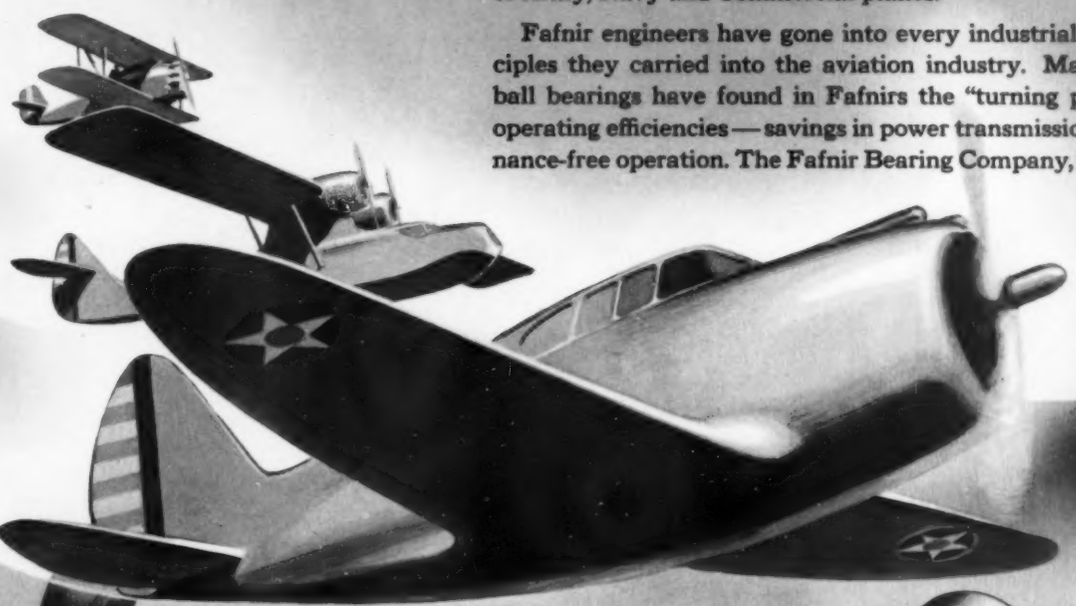
peacetime STANDARDS that became WARTIME ESSENTIALS . . .

"Fafnirs on the controls" has become a byword throughout the aviation industry. Many of the control features that give American-built aircraft the edge in battle today, are the result of Fafnir's peacetime efforts to provide bearings that assured stability, rigidity and the responsiveness that comes with friction freedom. Today Fafnir offers the most complete line of ball bearings for aircraft . . . all types for all duties. You'll find Fafnirs on the controls of Army, Navy and Commercial planes.

Fafnir engineers have gone into every industrial field with the same principles they carried into the aviation industry. Many thousands of users of ball bearings have found in Fafnirs the "turning point" to greater machine operating efficiencies — savings in power transmission — and low-cost, maintenance-free operation. The Fafnir Bearing Company, New Britain, Connecticut.



168 HOURS A WEEK

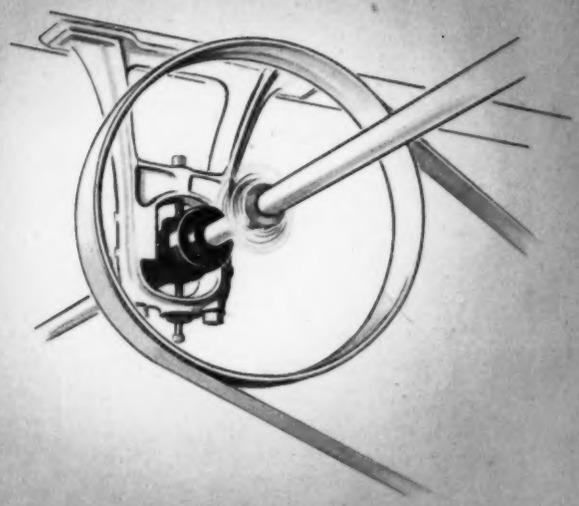
Production has been placed on a "round-the-clock" basis to meet the demands for ball bearings for mechanized equipment, and the machinery to make it. But production of enough "war" bearings is possible only by curtailing the manufacture of certain other types and sizes of bearings. If you are not able to get the type of bearing you have used previously — you will understand why.

FAFNIR

Ball Bearings

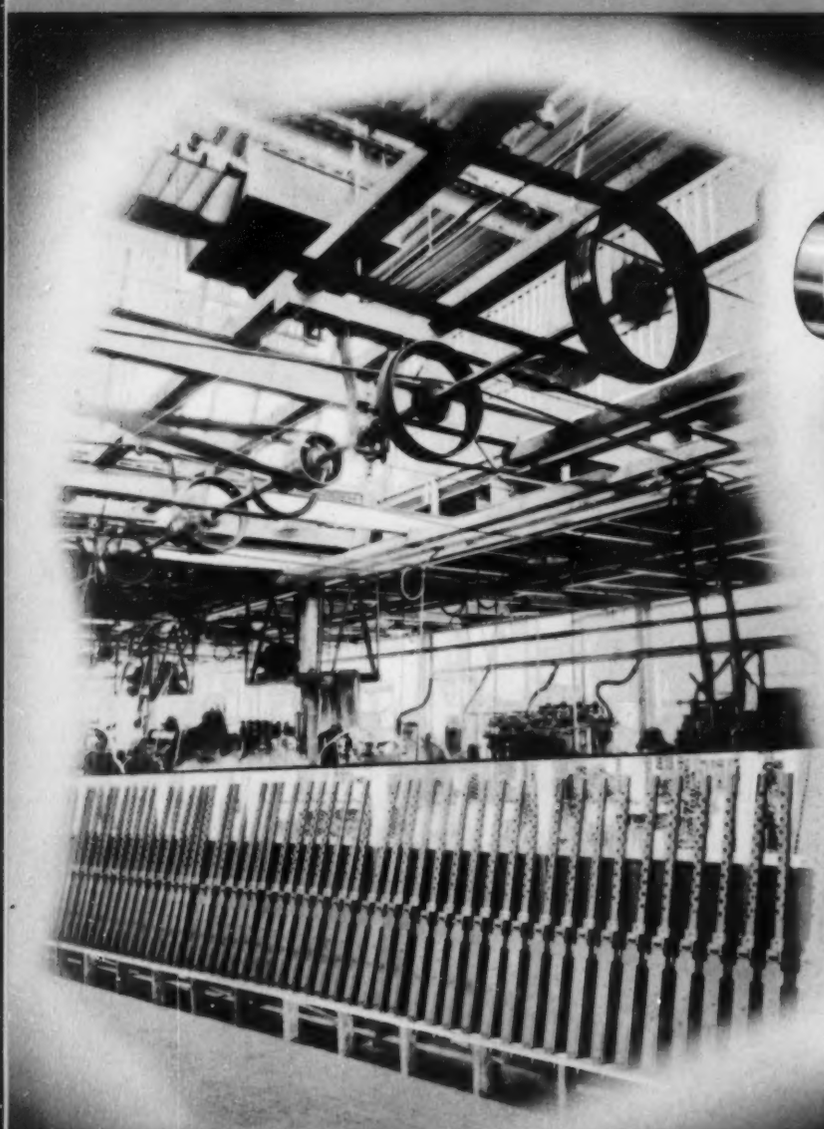
THE BALANCED LINE
FOR ORDNANCE, AIRCRAFT AND
INDUSTRIAL MACHINERY

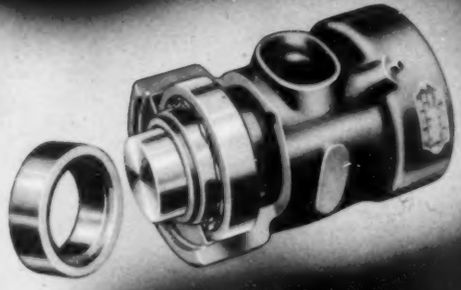
Short Cut to FAST PRODUCTION...



Starting from "scratch" — with old, rebuilt machine tools — a Connecticut manufacturer broke all records getting into production on an order of heavy machine guns. Yankee ingenuity — and easily installed, friction-free Fafnir Double Ball Bearing Hanger Boxes helped him do it!

With motors scarce, individual drives for the machine tools were out of the question. Production couldn't wait. The firm's engineers solved their problems with a unique lineshafting system and quickly installed the Fafnir Hanger Boxes. At the same time, three *other* major problems were automatically solved... machine performance was improved, maintenance reduced, and power was conserved. Fafnirs have been the "answer" to production speed-ups in many war-busy plants. The Fafnir Bearing Company, New Britain, Connecticut.





4 NEW PLANTS

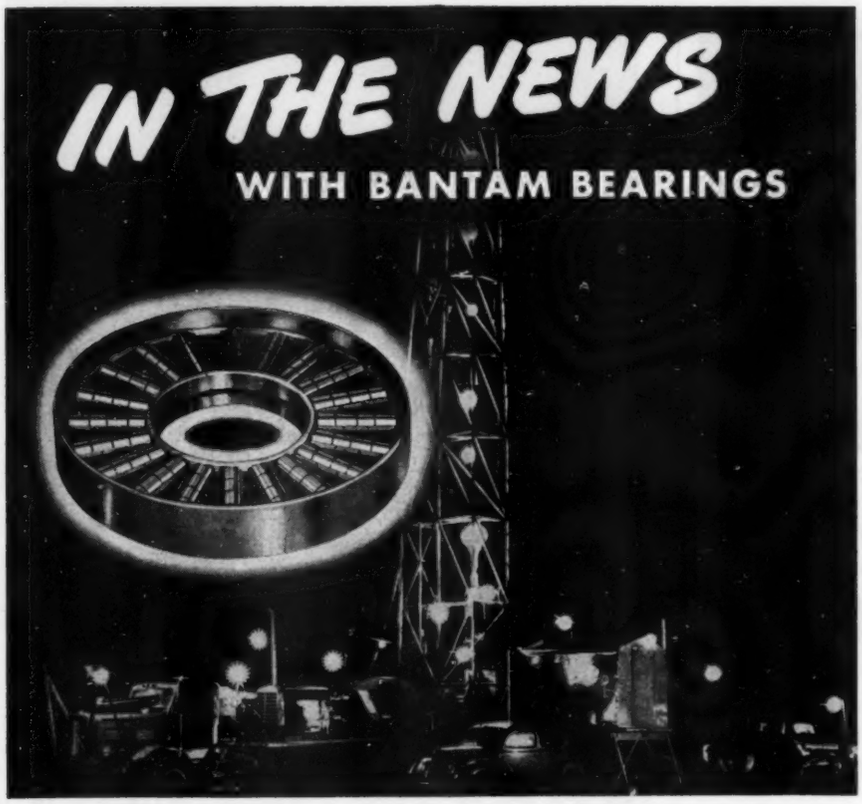
One new plant BUILT, *two new plants* BOUGHT, *one new plant* LEASED... *thus has Fafnir tried to keep pace with the tremendous increase in demand for ball bearings for mechanized war equipment and the plants and machines to build it. We hope these expanded facilities will permit us to supply the bearings you need, in the quantities you need, when you need them.*

FAFNIR

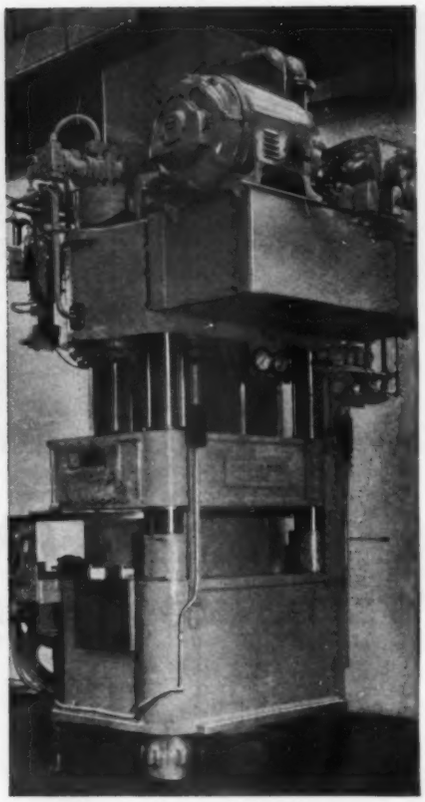
Ball Bearings

THE BALANCED LINE
FOR ORDNANCE, AIRCRAFT AND
INDUSTRIAL MACHINERY

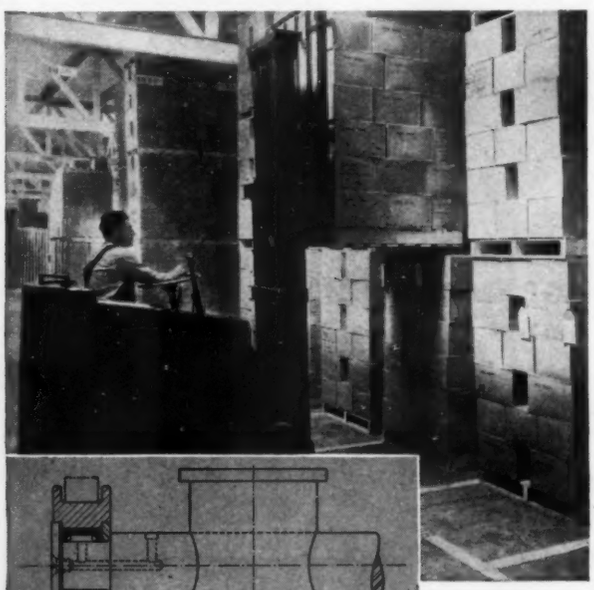
IN THE NEWS
WITH BANTAM BEARINGS

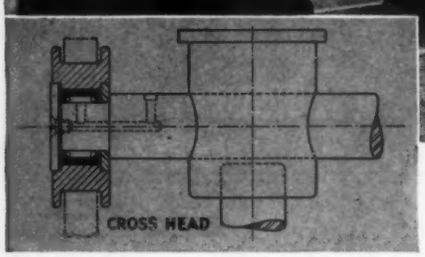


OIL IS AMMUNITION—and in the search for new sources of this essential war material modern drilling equipment is playing a vitally important role. Typical example of progressive design is this portable drilling unit built by Franks Manufacturing Corporation for quick location-to-location moves. Drawworks, pumps, auxiliary engines, and rotary drive equipment are mounted on a single truck—and derrick can be folded down by special patented screw mechanism. Main thrust bearing on swivel of this and similar Franks units is Bantam Flat Segmented Roller; main bearing and upper radial bearing in rotary table are Bantam Tapered Roller.



AIRCRAFT PARTS are formed in this 1200-ton three-column press made by Williams, White & Co. It is powered by an Oilgear Two Way Variable Displacement Pump equipped with two type ALI Bantam Radial Roller bearings on front and rear of rotor to insure efficient, dependable operation at all times.





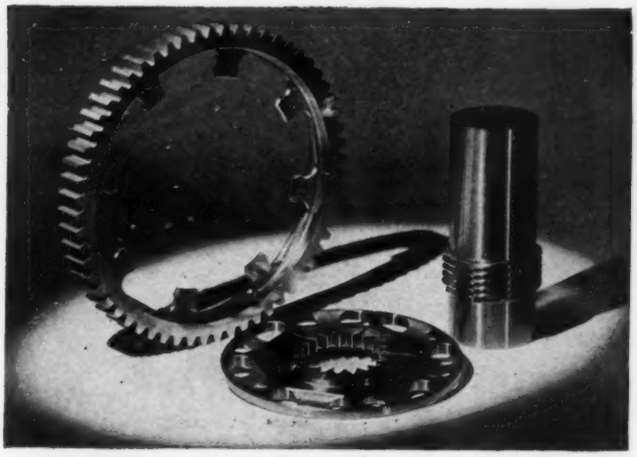
MAN-HOURS SAVED in handling materials help keep production at peak levels. Lift trucks built by MacDonald Truck and Manufacturing Co. are designed throughout for safety, smoothness, and speed—and MacDonald selected Bantam Quill Bearings for use on cross-head (shown in cross-section drawing) and on tilt arms of these trucks.

BATTERIES OF THESE POWER-SQUARING SHEARS are being used in war production plants for squaring and trimming metal sheets and for producing narrow strips. Among the many progressive engineering features included by Niagara Machine & Tool Works is the use of Bantam Quill Bearings on the main shaft. For further information on these compact, high-capacity anti-friction bearings, write for Bulletin D–104.

BANTAM BEARINGS

STRAIGHT ROLLER • TAPERED ROLLER • NEEDLE • BALL

BANTAM BEARINGS CORPORATION • SOUTH BEND • INDIANA



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Investigate Perkins facilities for producing the gears you need. You'll find that your most exacting requirements can be met, exactly to your specifications—from any material —in any quantity.

Our facilities for producing precision, custom-cut gears include modern gear generating machinery; our heat-treating and inspection equipment enable us to produce to the desired degrees of hardness and closest limits of accuracy.

All requirements of war production can be met by Perkins whether it's gears for precision instruments, aircraft motors or any other equipment.

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HELICAL GEARS	BEVEL GEARS
SPIRAL GEARS	RATCHETS
WORM GEARS	GROUND THREAD
SPUR GEARS	WORMS

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"When your specifications call for special gears — Spur — Bevel — Mitres — Helical — Worms and Worm Gears —Reduction Units—Why not try GRANT.

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SIX THINGS A MAN CAN DO

IMAGINEERING

★ SO MUCH SO SOON ★

1 ***MAKE OUR OWN JOB MORE PRODUCTIVE.*** Every man jack of us can. And that's not preaching, either. It's the point of view we've adopted for the duration at Alcoa. The records we've broken so far, we tell ourselves, aren't nearly good enough. Nor shall we be satisfied with the new ones we set tomorrow.

MAKE OUR MACHINES MORE PRODUCTIVE. There is a way. We don't know the answer for your equipment. But we have found the answers for many of our own machines which we thought were already up to top output. The resulting step-up is getting planes into the air faster. And it is doing things to aluminum prices. Designers please note.

III ***PRACTICE PREVENTIVE MAINTENANCE.*** Keeping present equipment in top condition is easier than getting new. One of the ways our engineers are helping production everywhere is in counseling users of aluminum equipment on means of preventing unnecessary corrosion. The remedy is usually simple; the results priceless. Ask us.

FOUR ***BUY WAR BONDS AND STAMPS.*** It's patriotism with self-interest. You finance the war and you help to defeat inflation by refusing to spend for nonessentials. Moreover, you finance yourself to take advantage of all the revolutionary new products that are going to be ready to buy when the war is over. Buy today to keep your own wheels turning tomorrow.

FIVE ***DREAM A DREAM EVERY DAY.*** Remember that the kind of peace we all want depends on how many jobs we think up for the boys coming back. New jobs come out of new things to make. Let your imagination soar; engineer it down to earth; then file the plans away, ready for the day when. That's Imagineering! Selfish suggestion: think seriously in terms of Alcoa Aluminum.

Sixth and last ***KEEP THE OLD CHIN UP.*** Whatever the news, whatever the temptation, keep the chin up. The boys out there deserve it. Whether it's rationing, or restrictions, or whatever, let them watch us being soldiers about that.

Aluminum Company of America, 2107 Gulf Bldg., Pittsburgh, Pa.

ALCOA ALUMINUM

YOU CAN SEE BY THE RECORDS PHILADELPHIA SPEED REDUCERS ARE PHYSICALLY FIT FOR WARTIME SERVICE

A Philadelphia Worm Gear Reducer installed in the Electrical Maintenance Department of an Eastern Transportation Company.

Yes, Philadelphia Speed Reducers of all types, when properly selected for the intended service will solve your problem of transmitting power with a high degree of efficiency to the machines running long, steady hours, turning out the weapons of war.

Philadelphia Units are ruggedly constructed and amply housed with sufficient area for heat dispersion. Each one embodies certain custom built qualities and individual service characteristics that assure its performing efficiently and with little attention.

With a complete line to choose from we can recommend the right unit for your next drive problem . . . Write for catalog.

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New York, Pittsburgh, Chicago

***Philadelphia* LIMITORQUE CONTROL**
operates all types of valves, etc., safely, economically, from convenient stations.

***Philadelphia* GEARS**
All types and sizes of industrial gears. Can be supplied in all materials.

***Philadelphia* WORM GEAR SPEED REDUCER**
right angle drives — vertical or horizontal. Wide range of ratios and horsepowers.

***Philadelphia* MOTOREDUCER**
The economical self-contained drive, Horizontal or Vertical types — various ratios and horsepowers.

***Philadelphia* HERRINGBONE SPEED REDUCER**
for heavy loads at high speed. Single, Double, Triple Reductions, various ratios and horsepowers.

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(Straight & Spiral)
WORM GEARING • THREAD GRINDING
(14 to 96 D. P.)

This range logically embraces the gear components of many critical control devices essential to the war effort and this organization is proud of its contributions of such material in the program.

With full *production capacity* scheduled far into the future, all new inquiries are now necessarily subordinated to these vitally important prior commitments. However, every *urgent* need will be given careful consideration.

Gear Specialties
MANUFACTURERS
CHICAGO

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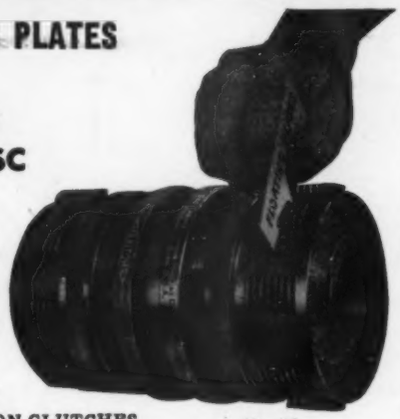
THE JOHNSON FRICTION CLUTCH

HAS FLOATING PLATES

THE NEW "MAXITORQ" MULTIPLE DISC DESIGN.

. . . for better clutch performance under ANY CONDITIONS



Double "Floating Plates" in neutral

Single

More than thirty years of successful application of JOHNSON FRICTION CLUTCHES to practically all power transmission demands is behind every recommendation made by our Engineering Department.

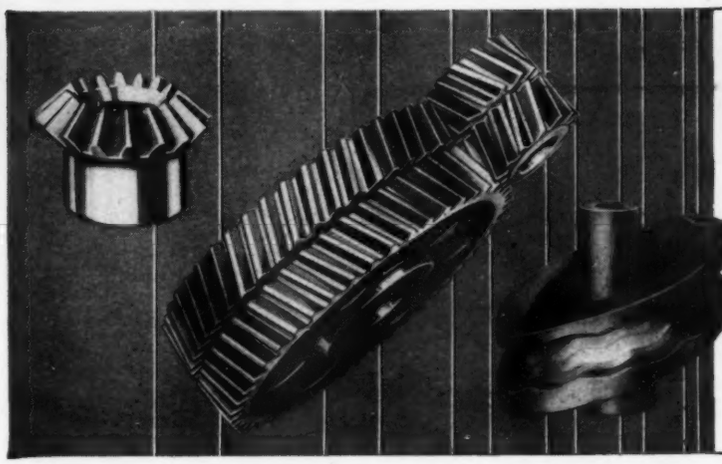
You can, therefore, depend on better clutch performance regardless of the severity of operating conditions, when you bring your clutch problems to JOHNSON Engineers for study.

Among the operating features which contribute to better performance are sensitive starting, safety, cleanliness, quietness, efficiency and long life.

You incur no obligation in asking us to show specifically how you can improve power transmission on your machines. Just give us the details of your problem.

Write for Multi-Disc Clutch Catalog No. 84 or Consult "Sweet's" or "Thomas' Reg."

THE CARLYLE JOHNSON MACHINE CO. MANCHESTER, CONN.



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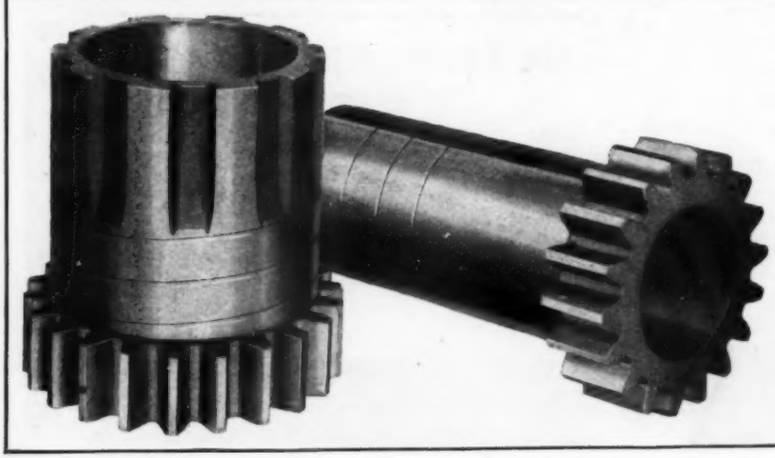

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SPUR — HELICAL — WORM
BEVEL — MITER — RACKS

Splined Shafts A Specialty

THE ADAMS COMPANY
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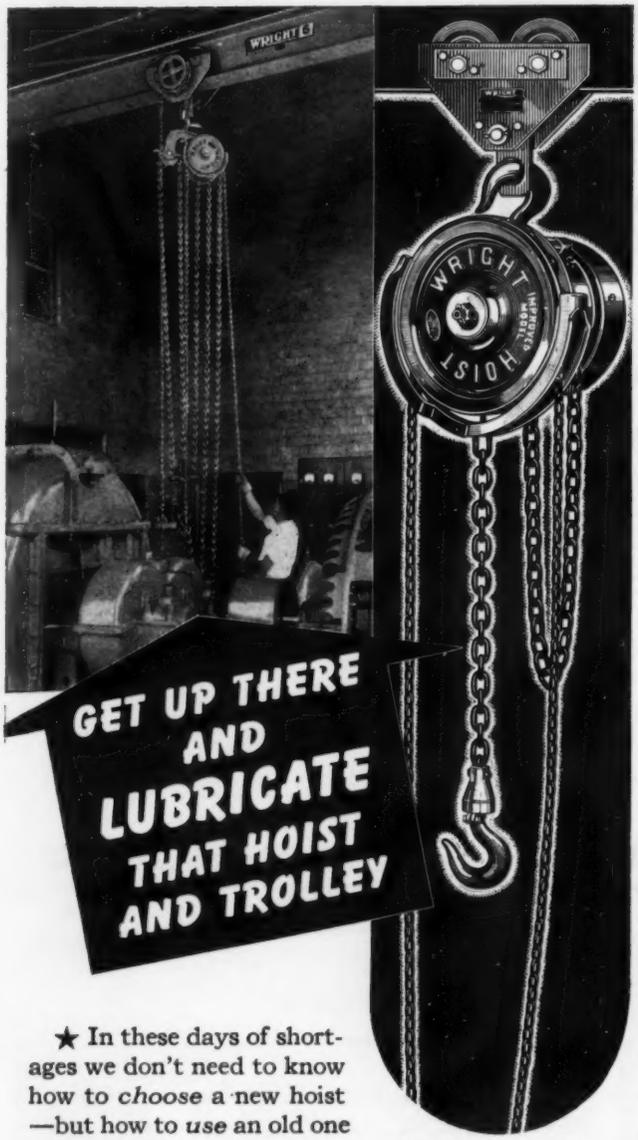

★ In these days of shortages we don't need to know how to *choose* a new hoist —but how to *use* an old one more efficiently, and how to make it last longer.

So—get busy with the grease gun! Where properly lubricated and maintained, many **WRIGHT HOISTS** have given constant, trouble-free service for 20 and 25 years. We have known other hoists to be so badly abused they were ruined in *two* years. Your **WRIGHT HOIST** will last indefinitely if you treat it right.

If your hoist is under constant use, as on assembly line work, inspect and lubricate it every month. If it is subjected to ordinary occasional service, then perhaps lubrication every three months and inspection every six months is sufficient. But keep your load chain well lubricated at all times. A lubricated chain will *far* outlast a dry chain.

Conserve steel and maintain production schedules by regular inspection and lubrication.

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AMERICAN CHAIN & CABLE COMPANY, INC.
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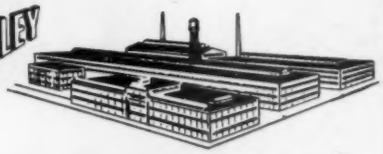

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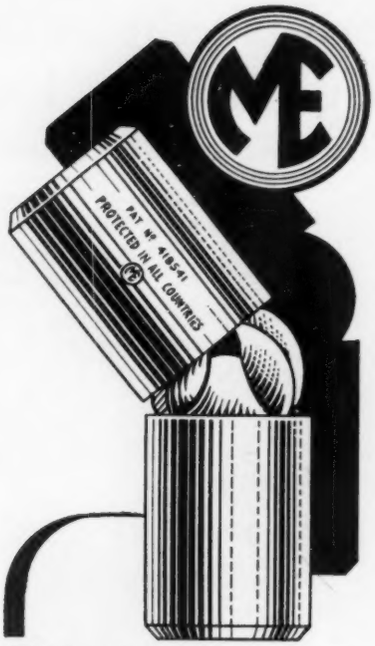

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- Made in a range of 9 sizes for shaft diameters ¼" to 1⅜".
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ALL-OUT PRODUCTION FOR VICTORY

Dalzen

THREAD GRINDERS, TAPS and BROACHES are speeding up production

Shown above are some of the broaches and taps manufactured by Dalzen. The broaches are made in rounds, flats or form. The taps are Whitworth and British Association form.

43" WIDE 39" DEEP 72" HIGH

48" WIDE 38" DEEP 75" HIGH

The Dalzen No. 1 Thread Grinder will grind threads up to ten inches in length anywhere on an eighteen inch shaft with a diameter maximum of six inches. The Dalzen No. 2 grinds threads up to four inches in length anywhere on an eight inch shaft with a diameter maximum of three inches.

Do much more • *take less floor*

Today two things are of paramount importance in American Industrial Plants: (1) more work, higher speeds and (2) most effective utilization of given floor space. Dalzens meet both requirements and you can use the saved floor space for added equipment or more efficient tool arrangement. Interested in more output in less space?

WRITE FOR BULLETINS

DALZEN TOOL & MFG. CO.

12255 E. 8 Mile Road **Detroit, Mich.**

KEEP 'EM ROLLING

...Longer!

How to Lengthen the Life of Your Ball Bearings

Every BCA Ball Bearing is made to give long service in its particular field of application. Both machine makers and machine users can lengthen the life of these sturdy bearings still further by taking the simple installation and maintenance precautions listed below. Slow down bearing replacement and speed America's war production! BEARINGS COMPANY OF AMERICA, LANCASTER, PENNA.

SIX WAYS TO REDUCE BEARING REPLACEMENT

1. Use bearings that are correctly sized for the shaft.
2. When installing the inner ring, avoid striking or pressing the outer ring, balls or retainer.
3. Never force the outer ring into its housing by means of blows or pressure on the inner ring.
4. Heed the stated capacities of bearings. Don't overload.
5. Oils and greases used for lubrication must be neutral mineral lubricants and free from solid substances of any kind.
6. Give all possible protection from dirt and moisture.

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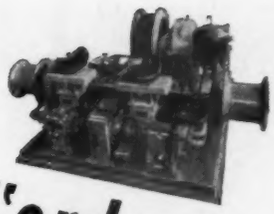
BALL BEARINGS



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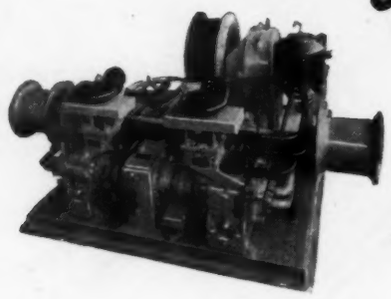

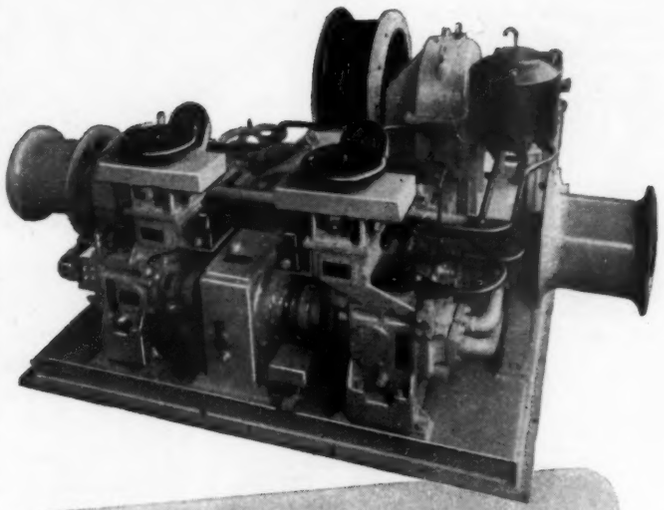

These electro-hydraulic winches are typical of the special hoisting machinery developed and manufactured by BAYARD. They represent just one instance of the many types of naval equipment designed, engineered and furnished by this company to individual specifications.

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BAYARD

The coveted Navy "E" Pennant—awarded to Bayard for excellence in fulfilling Naval contracts.

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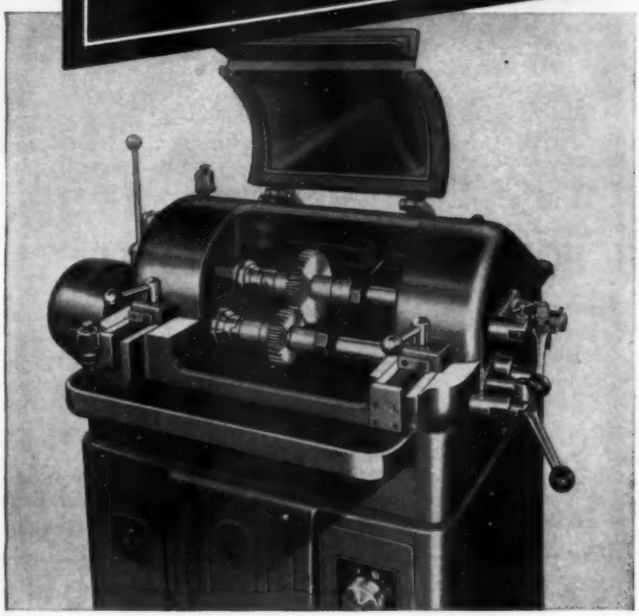
ONLY THE EAR CAN DETECT NOISY GEARS

RED RING GEAR SPEEDER *Provides* More Effective Lower Cost Listening



It costs too much to assemble gears in a transmission or other assembly, then have to reject them for noise.

The Red Ring Gear Speeder provides a simple, easy, low cost method of checking gears for noise—*before assembly.*

It is a listening device—easy to operate—and may be used anywhere—needs no soundproof room. Gears are mounted in pairs on spindles and are run at appropriate speeds. The operator places his ear at the mouth of the acoustical horn. The horn magnifies the sound of the gears 50 times—making objectionable noise easily detectable.

Various set-ups are available—you can get a Red Ring Speeder for spur or helical gears.

Write for Bulletin

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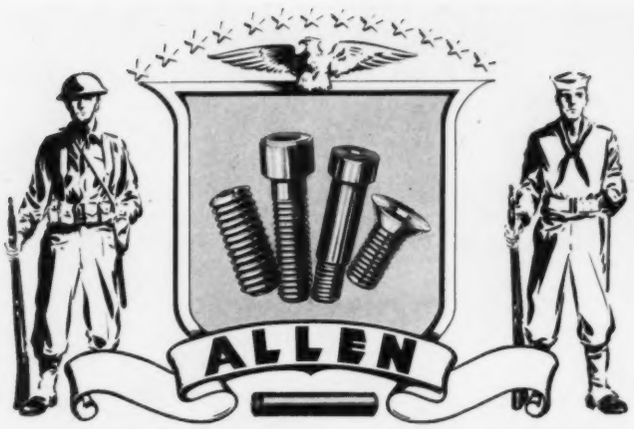

HOLLOW SCREWS

"1-A" Selectees at the Draft-ing Board

FIRST TO COME UP when drafting a new machine: (1) how to save material; (2) how to reduce the size and weight of component parts. Hollow Screws help *materially.*

"First selectees" in Hollow Screws are the cold-drawn and *pressur-formd* ALLENS. Because these processes bring out the strongest attributes of hollow screws,—the ultimate in holding-power; the utmost strength for the *size* of screw.

Thirty-two years of hollow screw specializing are "inducted" in Allen's service *this* year—the time of supreme test. Thirty-two years of plant development are "peaked" to provide needed *millions* of "Allens" each week.

Your local Allen Distributor will secure for you the largest shipments compatible with your priorities and our intensified production-effort.

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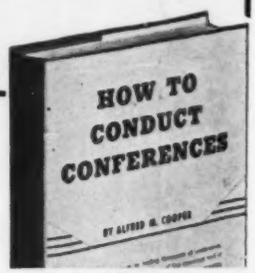

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EMPLOY THE UNSKILLED To Cut Perfect Threads

RIVETT THREAD TOOL

There is an army of unskilled operators ready to cut perfect threads with the Rivett Thread Tool. Not new, but proven, this tool helped win the last war and is again ready to throw its weight into Victory Production.

The Rivett Thread Tool is an attachment for any screw cutting engine lathe, and takes the place of single point thread tools commonly used. The tool is a holder for a ten tooth cutter with means for indexing the cutter to present each of the ten teeth progressively to the work. The first nine teeth rough out the thread in nine heavy, measured cuts, the tenth tooth finishes the thread. The responsibility of the operator is reduced to indexing the cutter when reversing the lathe. The thread tool does the rest.

Descriptive bulletin and ordering instructions are available on request.

RIVETT LATHE & GRINDER INC.
BRIGHTON, BOSTON, MASS.

(Advertisement)

LABOR PROBLEM EASED BY GANGING AUTOMATIC TOOLS . . . INDEXED OPERATION

In spite of the tremendous national effort to speed the training of machine operators, the supply of both men and women competent to take their place on war production lines is inadequate.

While this deficiency is to be expected in a peace loving nation forced into war, the enemy is warned that the designers of America's machine tools know very well how to increase the productivity of every available man by providing him with finer and faster tools.

This fact is well illustrated by the newest automatic dial-type multi-spindle machines developed by The Bodine Corporation of Bridgeport, Conn.

By combining the multiple operations of Drilling, Milling, Tapping and Screw Inserting in one machine, run by one man or woman, ordnance components are coming off the lines at hitherto unbelievable speeds.

Moreover the shortage of highly skilled mechanics is, in part, compensated for, as the time needed to train an operator for Bodine machines is considerably shortened.

ELECTRICAL INTERLOCKS PROTECT TOOLS, ADD TO SAFETY

Another problem of war production—high maintenance cost of tools and machinery—is largely solved by equipping Bodine machines with the maximum of protection against damage to tools, materials, and to the machine itself. . . . while also providing safety for the operator.

Electrical interlocks, safety guards, automatic ejection of finished parts, simplicity of both hopper and manual feeding, and a sure-fire automatic coolant system, are some of the protective features which make Bodines easier to operate by semi-skilled men or women.

There are six standard models, of varying capacities, which will handle the normal small and medium size ordnance parts. Some machines are so designed that interchanging of dials and tooling set-ups is possible, permitting work to be transferred from one model to another when a battery of them is installed.

Economy of Floor Space

The compact Bodine construction, plus the combining of several operations in one machine considerably reduces the required floor area . . . an important factor in crowded plants.

AUTOMATIC EJECTION OF PARTS

Unless the part is such that it might be damaged, and must be removed from the indexing dial by hand, automatic ejection is the usual procedure.

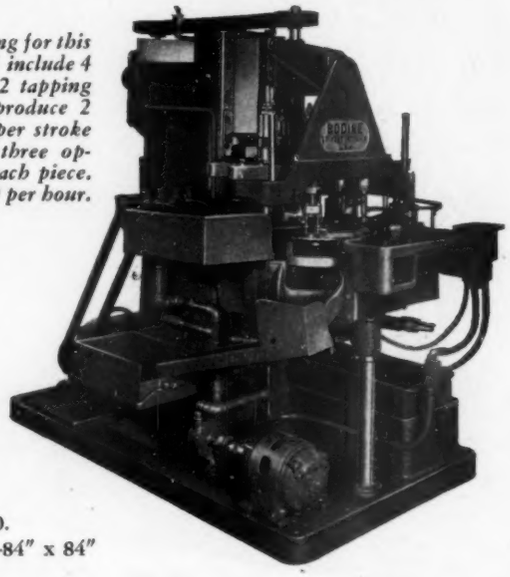
With the changes possible in dial construction and the greatest degree of flexibility in locating tools, the larger Bodine machines can be adapted for processing of parts in a wide range of shapes, sizes and types.

The purchase of Bodine machines is, of course, limited to plants now engaged in war production . . . but, and we stress the "but", the time is coming when the Bodine principle of design will play an important part in speeding production and lowering the cost of the thousands of new consumer products industrial research is now developing for the days of peace.

Bodine Simultaneously PERFORMS

DRILLING, MILLING, TAPPING AND SCREW INSERTING

Typical tooling for this model would include 4 drilling and 2 tapping spindles to produce 2 special nuts per stroke of machine, three operations on each piece. Average 2500 per hour.



Bodine 48-20.
floor space—84″ x 84″

When, as at present, production is dependent upon available machine tools and qualified operators, the flexibility of Bodine machines is a prime factor in speeding ordnance output. The basic principle of Bodine design permits the locating of multiple high speed spindles above, adjacent to, and below an automatic indexing dial for Drilling, Milling, Tapping and Screw Inserting... in combinations of two, three or all four operations during one cycle of the dial.

It is self evident that such versatility, translated into finished parts per hour, puts new records on production sheets. Moreover, the simplicity of feeding, automatic ejection, and electrical interlock protective features, enable even semi-skilled operators to maintain high production schedules. Full information to qualified plants, on request.

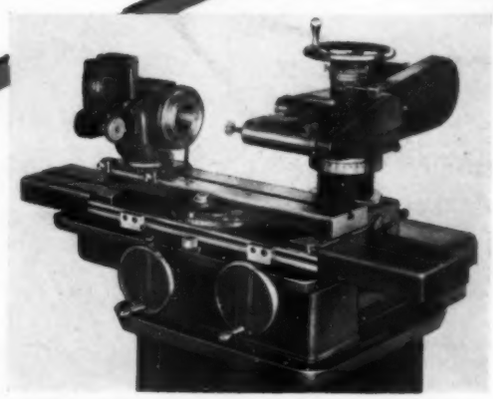
THE Bodine CORPORATION
BRIDGEPORT CONNECTICUT
AUTOMATIC DIAL TYPE DRILLING, MILLING, TAPPING, AND SCREW INSERTING MACHINES

THE SMOOTHEST-OPERATING GRINDER I EVER USED"

THE VERNON Universal Tool and Cutter Grinder fulfills a new degree of sensitive performance in grinding tools, cutters, internal jobs and cylindrical work. So smooth is its ball-bearing movement, the table literally glides its 17¼" travel.

Among the features included are: hardened steel table ways, ground in position . . . two-speed table traverse . . . intermediate auxiliary drive for internal grinding . . . fully universal spindle head . . . adjustable nuts on screws to eliminate backlash . . . spring-loaded table stops . . . motor driven workhead and coolant system **(standard extra)**. Many other construction features are described in our new bulletin. Write today!

THE *New* VERNON
UNIVERSAL TOOL and CUTTER GRINDER



INTERNAL GRINDING SPINDLE AND WORKHEAD — An intermediate auxiliary drive replaces the drive usually taken from the external grinding spindle—thus saving unnecessary wear. Pulleys are mounted eccentrically on arbor to permit easy belt adjustment. Two internal spindle speeds available. Workhead spindle mounted in Timken tapered roller bearings with three work speeds. Two tapers provided —No. 12 B. & S. and No. 50 N. M. T. B.

MANY ACCESSORIES ARE AVAILABLE FOR USE WITH THIS NEW VERNON

SPECIFICATIONS

Maximum table travel—17¼". Transverse travel of grinding wheel—7½". Vertical movement of head—6½" Centers swing 10½" diameter over table. Maximum work length between tailstocks—16", between headstock and tailstock—13½". Table swivels 45° each side of zero setting. Three external spindle grinding speeds, two internal spindle grinding speeds.

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With the drilling attachment shown above, easily secured to the base of the Super-Spacer, an ideal combination is available for drilling odd lots of flanges, hubs or other parts where spaced holes on a circle are required.

This modern, sturdy device can be depended on for accurate control of all machining operations for which its use is intended. It provides a fool-proof means of indexing on milling, drilling, slotting and planing. Its profit earning capacity is assured regardless of the quantity of work handled, returning its moderate first cost on single piece or quantity production.

Indexing is extremely rapid and positive with mask plates removing all possibility of error.

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THE HARTFORD SPECIAL MACHINERY CO.
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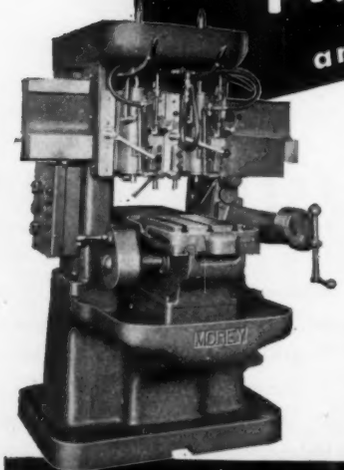
Preloaded Precision Bearings for Spindles

MOREY 12M HIGH-SPEED VERTICAL PROFILER and MILLER



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Speed and more speed in the production of interchangeable parts requiring milling of any contour or outline is yours in the MOREY 12M. Provision for increased clearance between spindles and table.

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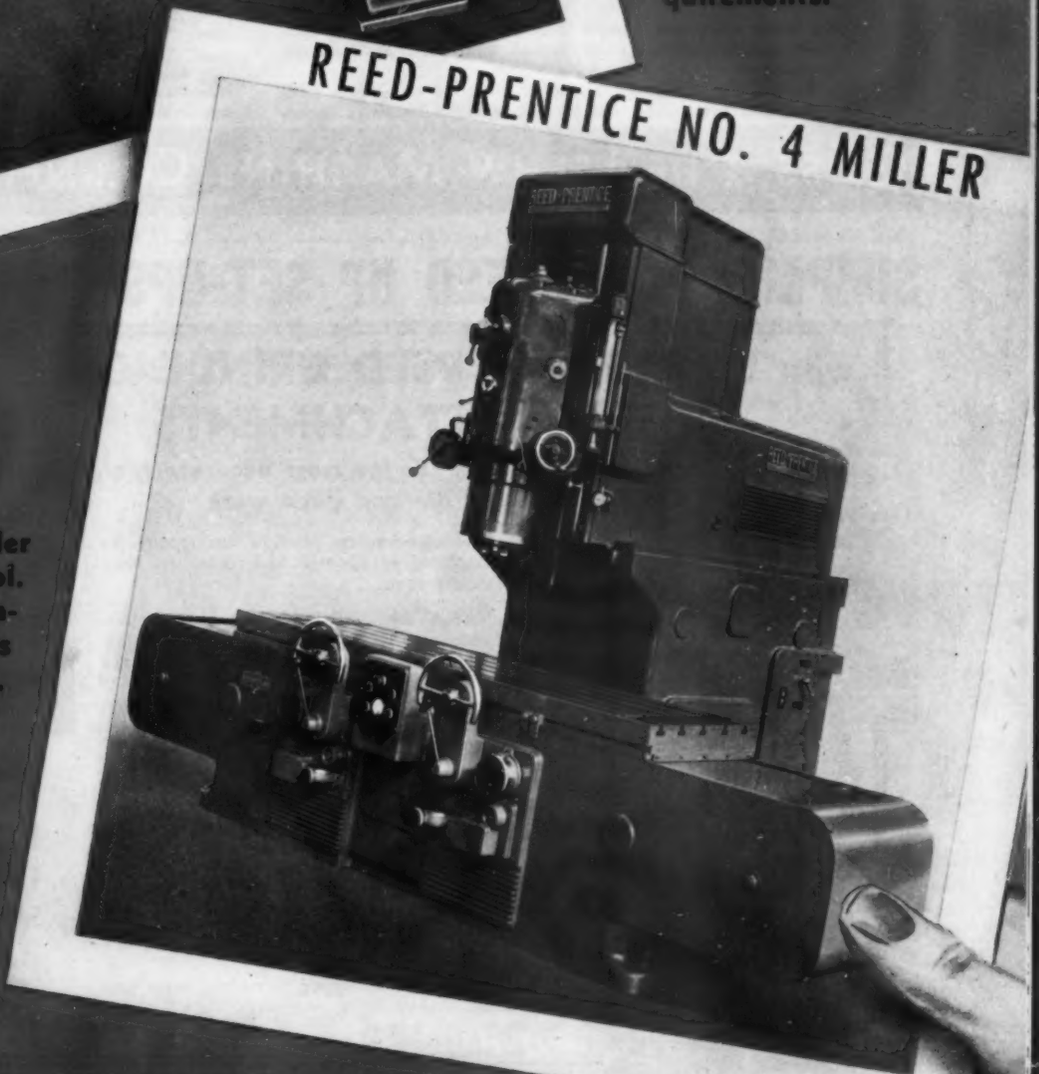
Two Headliners

REED-PRENTICE SLIDING GEAR HEAD LATHE

Reed-Prentice toolroom and engine lathes are well-known throughout the entire metal-working industry. Constant improvements in line with Reed-Prentice high standards of engineering and workmanship make the 14", 16", and 20" lathes suitable for your most rigid requirements.

REED-PRENTICE NO. 4 MILLER



The Reed-Prentice No. 4 Miller is our latest machine tool. Entirely new in design, it features infinitely variable feeds from ½" to 32" per minute. Dependability is insured by hydraulically-driven positive screw feeds to table and cross slide. Centralized control of table, cross slide, and head insure fast and efficient operation.

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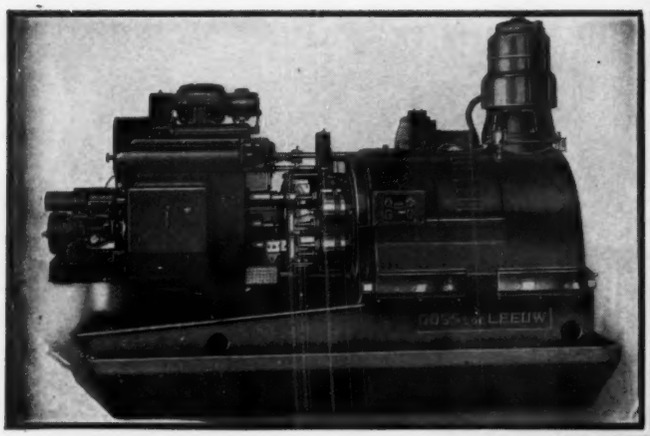
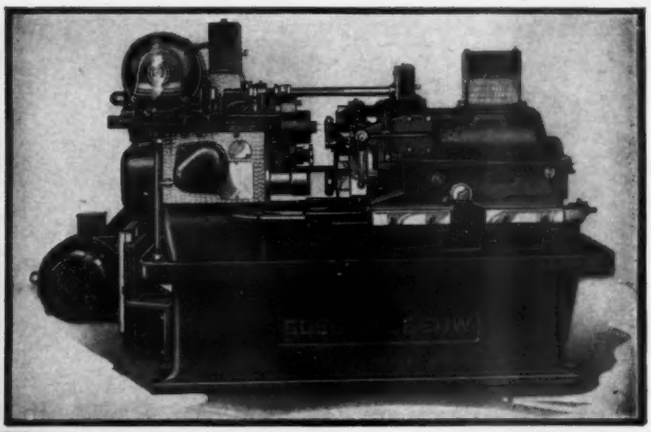
WORCESTER, MASS. ★ 75 West St., New York City ★ 1213 W. 3rd St., Cleveland, Ohio





WORK ROTATING TYPE

5 Spindles
6 Spindles
8 Spindles

GOSS & DE LEEUW *Multiple Spindle* CHUCKING MACHINES

TOOL ROTATING TYPE

4 Spindles
5 Chucking Positions

On these machines, two threading operations can be handled simultaneously, each thread controlled by its own lead screw.

Among the many other modern features offered in both types are: pre-loaded anti-friction spindle bearings, hardened ways, oversize spindles and gears of chrome-nickel steel, heat-treated.

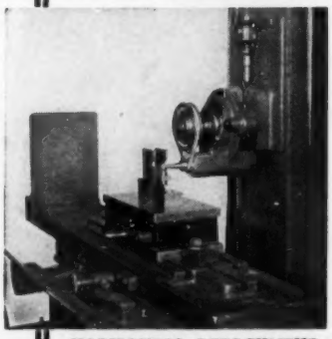
Complete details will be found in descriptive catalog available on request.

GOSS & DE LEEUW MACHINE CO., NEW BRITAIN, CONN.

SIMPLIFY *and* SPEED UP SET-UPS

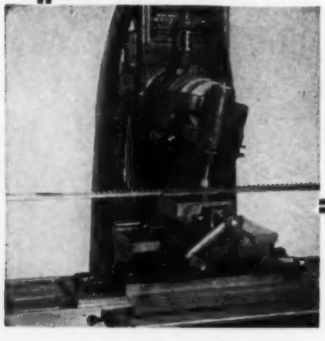
with LIBERTY HI-SPEED GRINDING ATTACHMENTS

Designed for the most accurate tool, die and gage work



HORIZONTAL ATTACHMENT
Grinding Gaging Seat on Special Gage

VERTICAL ATTACHMENT
Grinding Clearance of Broach Teeth



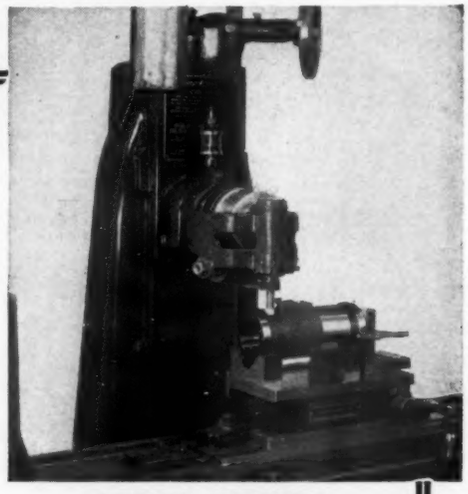
These new attachments provide the means for quick, simplified set-ups—in tool room, die shop and grinding room.

Applicable to the grinding of gages, angles, slots, recesses and difficult-to-get-at surfaces, Liberty Hi-Speed Grinding Attachments speed work and insure accuracy. Places impossible to reach with large wheels are readily accessible; long expensive set ups, requiring small wheels, are eliminated.

An almost unlimited variety of applications are possible with assurance of extreme accuracy wherever used. Attachment can be made quickly and shifted to numerous positions.

Liberty Hi-Speed Grinding Attachments are available for vertical and horizontal spindles and fit Browne & Sharpe, Reid and other makes of surface grinders.

These units are assembled complete with any size bores, pulley belts and grinding wheels at no extra cost



VERTICAL ATTACHMENT
Grinding Rectangular Opening in Trigger Casing

FOR COMPLETE INFORMATION WRITE TODAY—

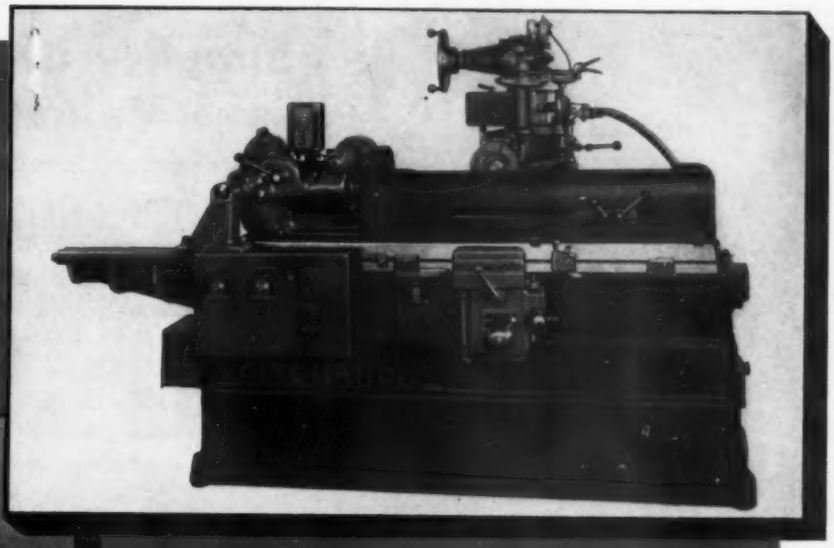
specifying diameter of spindle head, type and make of grinder. Also for Illustrated Descriptive Bulletin.

LIBERTY TOOL & GAGE WORKS

PROVIDENCE • RHODE ISLAND

FITCHBURG

Automatic Closed Cycle Grinding



Assures

ACCURATE SPLINES

Fitchburg formed wheel grinding method with automatic closed cycle, produces splines and gears with finer finish — higher degree of accuracy — higher speed in operation, resulting in smoother product performance.

Fitchburg technique also permits new operators to be quickly trained to produce accurate work — an important factor in speeding war production.

Fitchburg Grinding Equipment is in successful use in the largest industrial plants in the United States. Every day it is saving man hours.

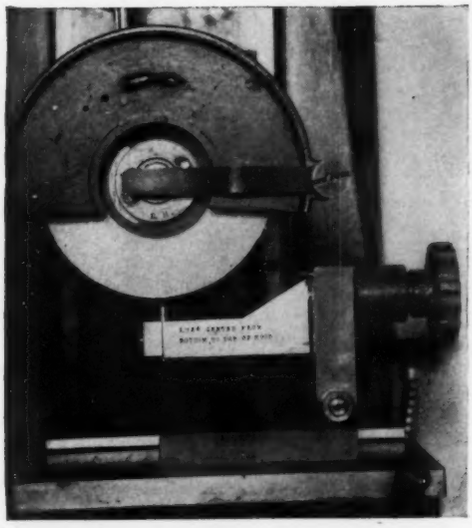
If you have any work of this character let Fitchburg engineers show you how to speed production by this modern grinding method.

Write today for this catalog showing wide range of successful operations.

FITCHBURG GRINDING MACHINE CORP.

FITCHBURG, MASSACHUSETTS, U. S. A.

Manufacturers of — Bowgage Wheelhead Units, Multiple Precision Grinding Units, Spline Grinders, Cylindrical Grinders, Gear Grinders, Bath Full Universal Grinders and Special Purpose Grinders.



Simplify Grinding Radii and save Valuable Time • • • •

with the NEW C-66 RADIUS DRESSER

1—Faster, more accurate dressing

2—Ability to dress for radii where clearance angle on radius is involved

3—No necessity to remove wheel guard

4—Open and easy to see dressing operation

5—Ability to rotate 180° or 90° in either direction, with stop pins

6—Simple setting of diamond

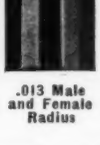
7—Ability to use several sizes of diamonds and hold them accurately in ground vee

8—Safety feature, hands are kept away from under the wheel

Price $72.50 without diamond, $5.00 extra with diamond

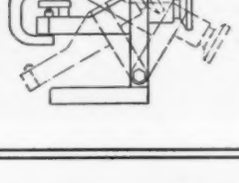
Diamond is set by measuring with micrometer from top of hood to bottom of arm.

Vee Ground in Center of Arm



.013 Male and Female Radius

.500 Male and Female Radius



Radius Dresser can be set at clearance angles for turning tools.

SCHULTZ & ANDERSON CO., 109 EDISON PLACE, NEWARK, N. J.

For production-plus
Simplicity of operation
Extreme precision
Versatility

ARTER ROTARY SURFACE GRINDERS

You can depend on Arter Rotary Surface Grinders to improve finish, cut costs, because they are made for fast, close tolerance work.

Arter grinding engineers are always ready to study your grinding problems and tell you how to get maximum precision production.

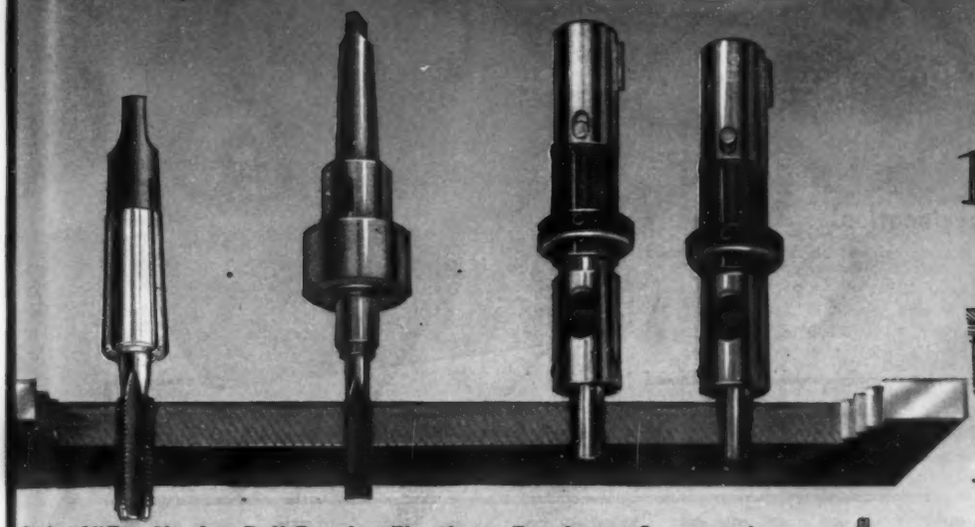
ARTER GRINDING MACHINE COMPANY

WORCESTER, MASSACHUSETTS • U. S. A.

FOR *High Speed* PRODUCTION

TAPPING

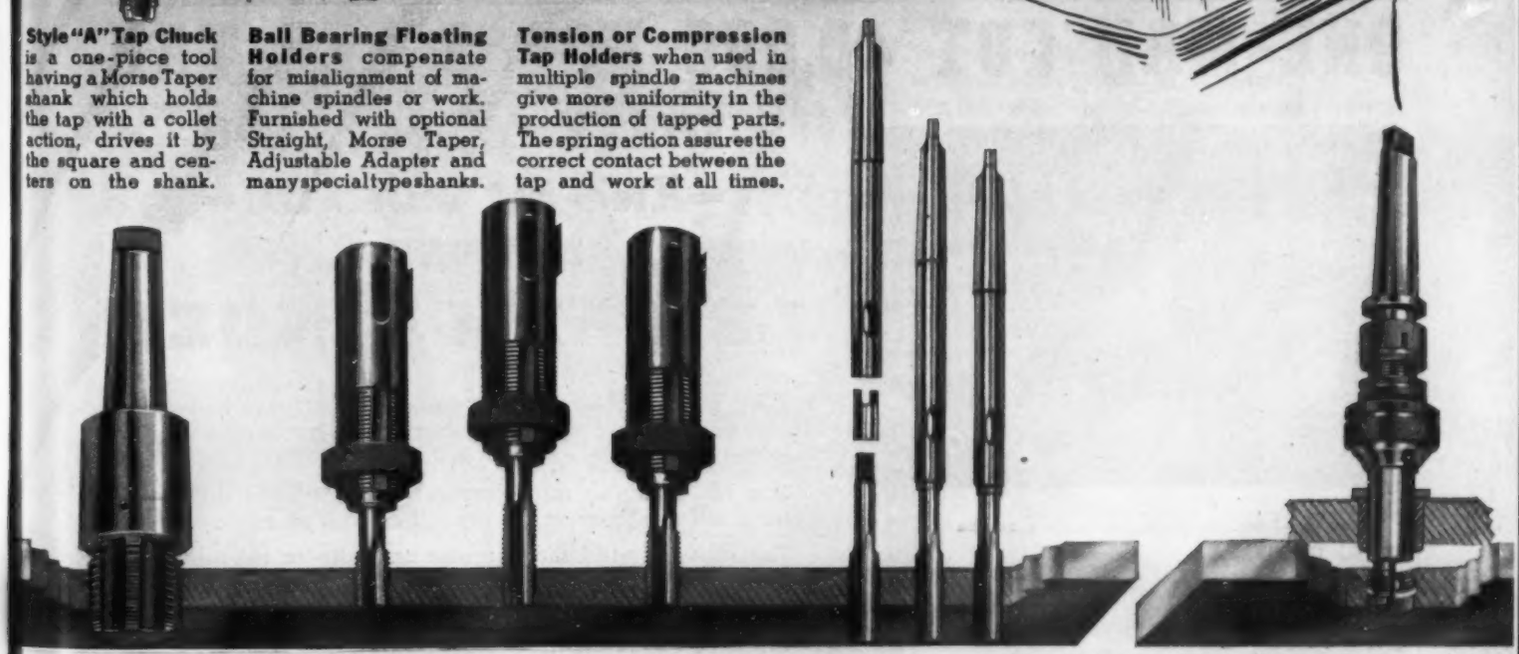
Style "B" Drill Chucks permit the use of straight shank jobber length drills in any spindle or holder with a Morse Taper hole.



Style "A" Tap Chuck is a one-piece tool having a Morse Taper shank which holds the tap with a collet action, drives it by the square and centers on the shank.

Ball Bearing Floating Holders compensate for misalignment of machine spindles or work. Furnished with optional Straight, Morse Taper, Adjustable Adapter and many special type shanks.

Tension or Compression Tap Holders when used in multiple spindle machines give more uniformity in the production of tapped parts. The spring action assures the correct contact between the tap and work at all times.



Heavy Duty Tap Holders for ...ving large size taps from ... to 3" in diameter. The tap ... held in position with set ...rews while a broached ...uare hole furnishes a positive drive. Morse Taper shanks ...less otherwise specified.

Adjustable Adapter Assemblies provide uniform adjustment in multiple spindle drilling and tapping machines. This tool permits quick, accurate adjustment for the tap without disturbing the entire set-up.

Furnished with Morse Taper, "Use-'Em-Up" or Stub Taper holes. Crest-ground Acme threads or "V" threads.

Close Center Tap Drivers are designed for multiple tapping operations where tapped holes must be very close together or where a shoulder or other obstacle on the work prevents ordinary tapping. Drivers are furnished in three standard lengths and are smaller in diameter than the spindles in which used.

Recessing Tools, with interchangeab... cutters, solve your problems in undercu... ting clearance grooves in tapped hole... Cutters covering a range of hole sizes fro... ½" to 1⅜" diameter may be used in one to... body thus reducing your production toolin... costs. Shank styles optional making thes... tools adaptable to all makes of machine...

SCULLY-JONES AND COMPANY

1901 SO. ROCKWELL ST., CHICAGO, ILLINOIS

"Blount"

MODEL F.T.C. 20 INCH
Special
WET TOOL GRINDER

. . . for the fast, grinding of accurate angles and clearances of Tungsten Carbide Tools

This New "Blount" Grinder can be depended on to meet your every requirement in the rough grinding of Tungsten Carbide tipped tools. The table, arranged for adjustment in all three planes, affords maximum convenience for the grinding of all possible angles.

"Table top is of hardened steel and ground. Milled guides are provided parallel to face of wheel in which the protractor guide slides. Table is supported by a heavy, bronze elevating screw with handwheel. Table may be raised or lowered approximately 2" from center of wheel. Angular adjustment up to 35° may be obtained in all planes.

A free hand grinding method is provided. Tool is held against protractor guide and thus directed against wheel at the proper angle.

Special wheels for this machine are available for grinding high speed steel or special alloy tools.

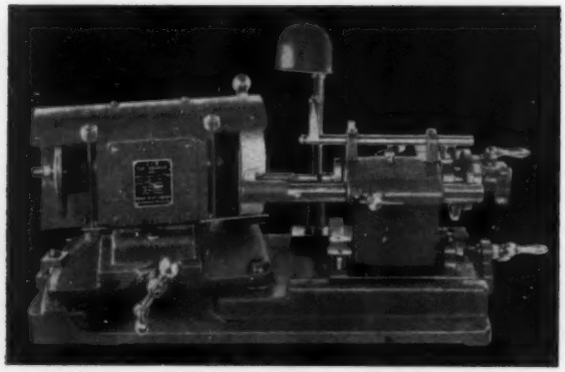
Condensed Specifications

Height to center of spindle: 36¾"
Bottom of pan to center of wheel: 10"
Pan: 37"x22½"x6"
R.P.M. spindle: 1000 optional
Dia. spindle in bearing: 2"
Bearing pillow block Timken tapered roller bearing equipped
Base: 28"x27½"
Grinding wheel: 20"x2½"x9"
Motor 2HP—1800 RPM.
Spindle drive: three V-belts

J. G. BLOUNT CO., EVERETT, MASS., U. S. A.

Write for leaflet A-6 giving complete description and specifications of this modern tool grinder.

ONE MAN GOT 40,000 HOLES PER TAP



INSTEAD OF 8,000
—AND SO CAN YOU—
BY USING A
J-B TAP GRINDER

Why buy new taps when you can get from two to ten times the number of holes from your present stock by keeping them sharp on the J-B TAP GRINDER?

The J-B is saving manufacturers hundreds of dollars by getting full use from every tap. It can do as much for you!

The J-B will grind the chamfer on right- or left-hand taps with 2, 3, 4, 5, 6, 8 and ten flutes. Capacity—No. 0 to 2". It is also ideal for grinding countersinks and other small tools.

Investigate the low cost J-B method by mailing the coupon today!

Please send me complete information on the J-B TAP GRINDER.

Name ..... *Title* .....

Company .....

Street .....

City ..... *State* .....

A. M.

MAIL THE COUPON TODAY ! !

EDWARD BLAKE COMPANY
634 COMMONWEALTH AVE., NEWTON CENTRE, MASS.

J-B TAP GRINDERS — FILTAIRE PORTABLE DUST COLLECTORS — AMERICAN TOOL HOLDERS — BLACK DIAMOND PRECISION DRILL GRINDERS

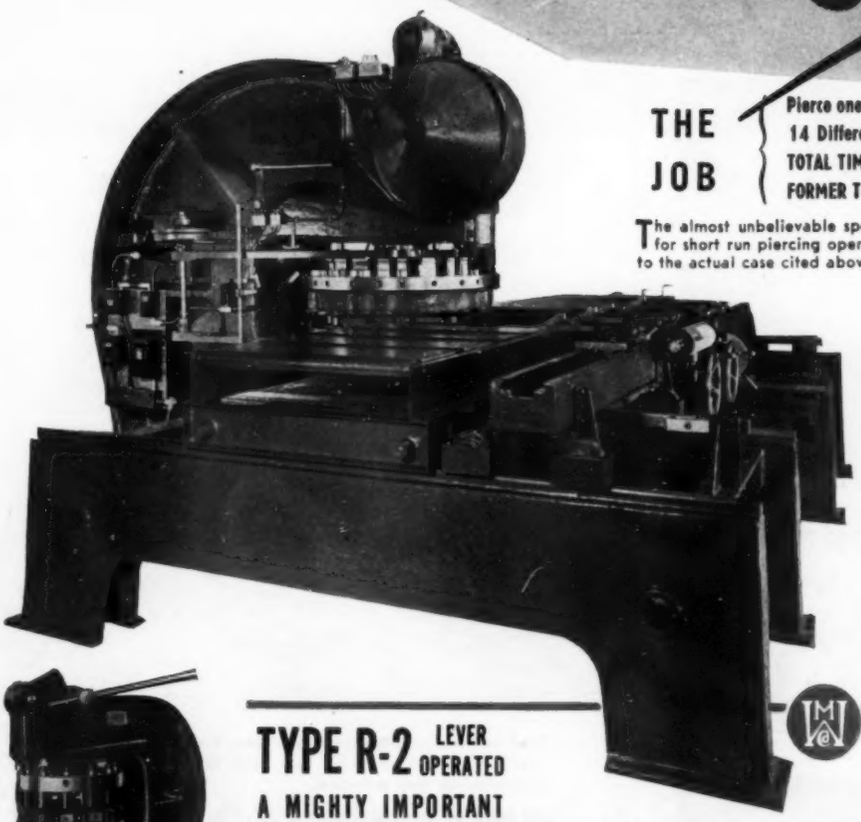
A STORY OF SHORT RUN PIERCING ECONOMY

TO PUNCH ONE PIECE COSTS .78

INSTEAD OF FORMER $7.83 COST....

on a WIEDEMANN TYPE R-7 TURRET PUNCH PRESS with GAUGE TABLE

...A PER PIECE SAVING OF $7.05



THE JOB

- Pierce one panel: .125" x 37⅝ x 53⅝ mild steel
- 14 Different Dies — 108 Different Holes Pierced
- TOTAL TIME FOR ONE PIECE — 40.11 min. (one operator required)
- FORMER TIME — Old Equipment — 6½ hrs. (2 operators required)

The almost unbelievable speed and accuracy of Wiedemann Turret Punch Presses for short run piercing operations is attested by hundreds of users' reports similar to the actual case cited above.

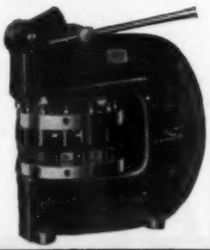
The Wiedemann Turret Punch Press is the only truly economical method of short-run production for any sheet metal or plate shop in the aircraft, electrical, electronic, industrial sheet metal, radio, and shipbuilding industries. It is ideal equipment for production, experimental and laboratory piercing of sheets or plates.

Type R-7 shown (on which example was produced) exerts a pressure of 160,000 lbs. 24 to 32 stations with 54" throat depth. Only one operator required for any job. Layout and piercing is performed in same operation — all layout readings are taken from blueprint or chart — and are immediately positioned on gauge table and work is pierced.

Get the facts — Write today for new bulletin about the Wiedemann Economy Piercing Method.

WIEDEMANN MACHINE CO.

1815 Sedgley Ave., Philadelphia, Pa.



TYPE R-2 LEVER OPERATED

A MIGHTY IMPORTANT PUNCH PRESS FOR EVERY METAL WORKING SHOP

Replace drilling operations and punching with hand tools. Eliminate changing of punches and dies. R-2 punches smaller die holes in mild steel up to ¼" clean enough to be tapped. No distortion even up to full capacity of 15,000 lbs. All punches equipped with centers. As good for experimental work as for production small run piercing. Write for details on R-2—the time and money saver for every shop.

WIEDEMANN TURRET PUNCH PRESSES & GAUGE TABLES

USE THE SCHERR COMPARITOL for SPECIAL MEASURING PROBLEMS

Used in leading plants for precision inspection to 1/10,000" on plug gages, cylindrical ground work, screw machine parts, flat pieces and other types of work, the SCHERR COMPARITOL can be furnished with special tables, anvils and spindles to meet your specific problem.

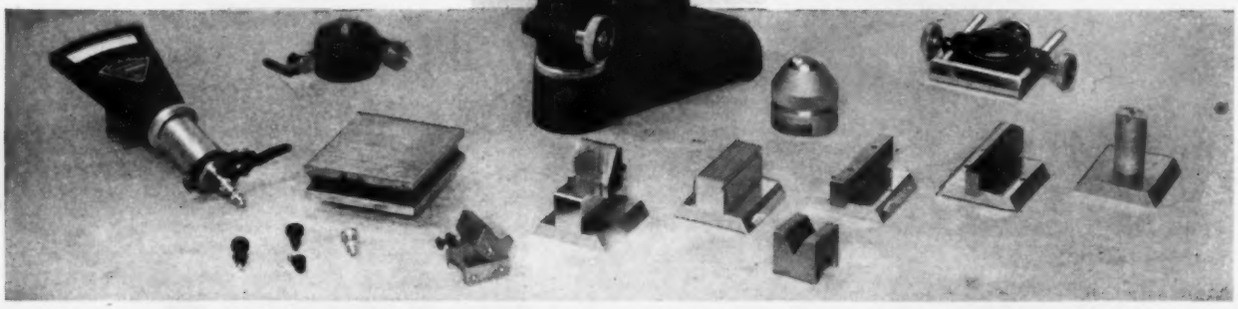
The COMPARITOL is available in two sizes, the Standard measuring from 0 to 6" and the Heavy Duty from 0 to 8"; range is .004" plus and minus graduated to read to 1/10,000.

WRITE TODAY FOR FOLDER, QUOTATION AND DELIVERY DATES

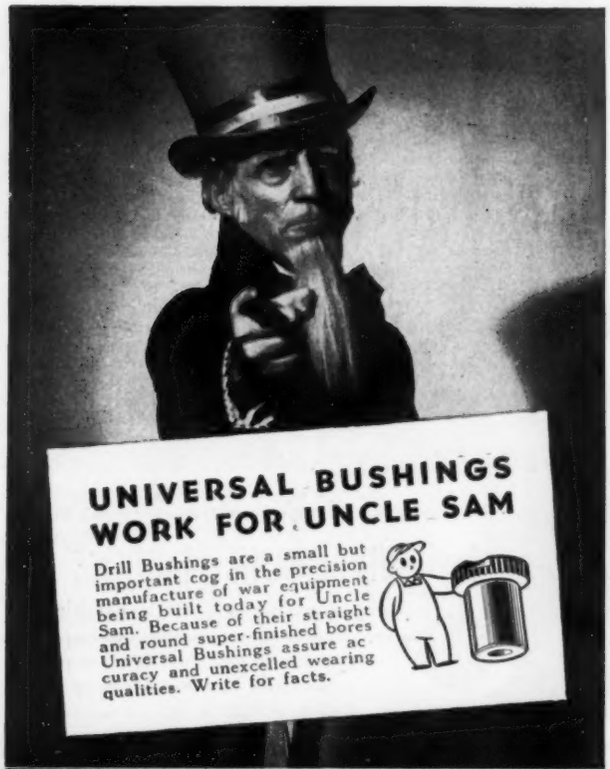
THE SCHERR COMPARITOL can be furnished with attachments as follows:

- Measuring Head only for building into fixtures, for special measuring applications.
- Ground and lapped flat table (4" x 4") to accommodate heavy plug gages and large work.
- Hardened and ground V-blocks in various sizes for detecting out of round.
- Back stops for attachment to table for fast production checking.
- Feeler points with hardened steel balls, tungsten carbide, diamond and sapphire tips.
- Anvils of various lengths and widths, with or without serrations for special types of work.
- Ball anvil for measuring very thin work such as crystals, laminations, etc.

THE SCHERR COMPARITOL will aid in solving your own particular inspection problem. Write for complete details.



GEORGE SCHERR COMPANY, INC. 124 LAFAYETTE ST., NEW YORK, N.Y.

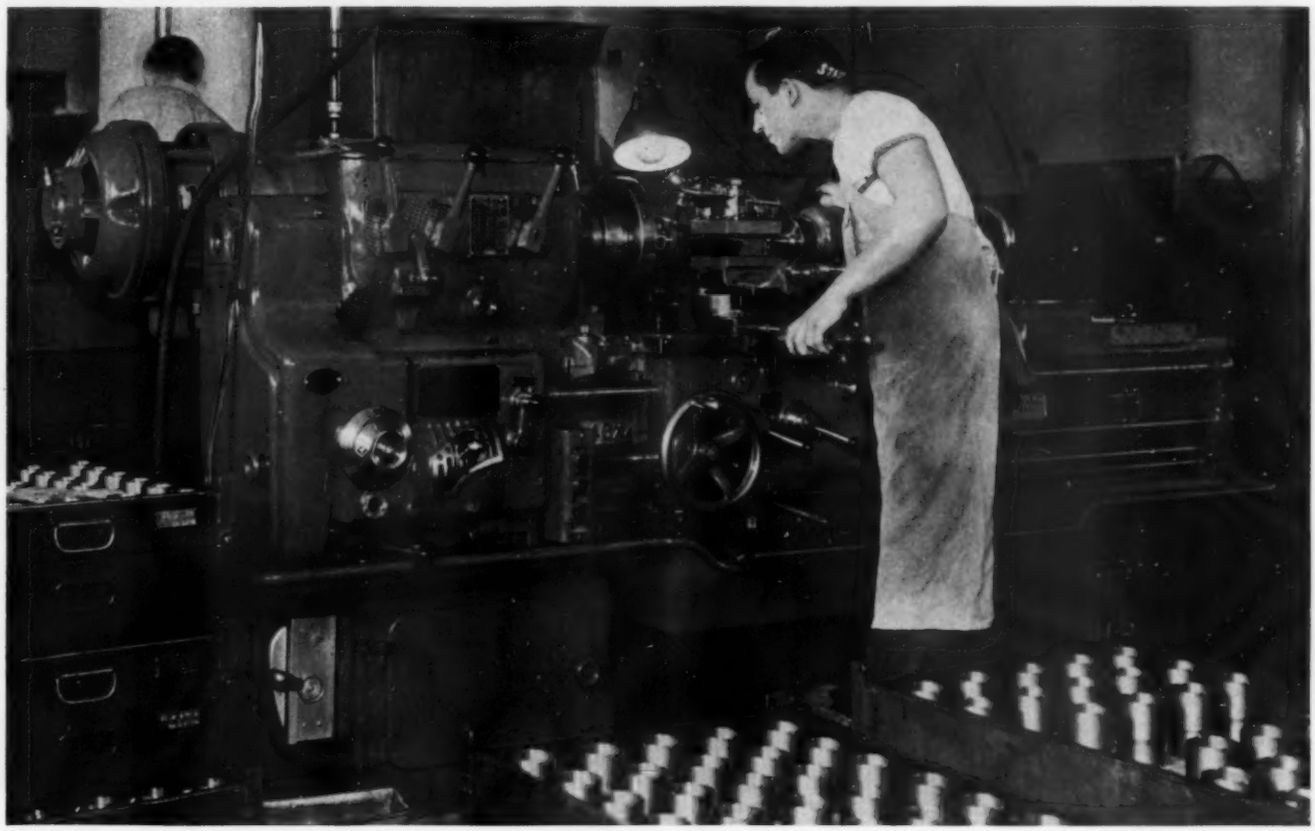

UNIVERSAL BUSHINGS
WORK FOR UNCLE SAM
Drill Bushings are a small but important cog in the precision manufacture of war equipment being built today for Uncle Sam. Because of their straight and round super-finished bores Universal Bushings assure accuracy and unexcelled wearing qualities. Write for facts.
UNIVERSAL ENGINEERING CO.
FRANKENMUTH - MICHIGAN

Characteristic of the design of all STURDIMATIC LIVE CENTERS is a low overhang and a slight cushioning action . . .
that compensates for expansion due to heat, shock and excessive thrust loads—reducing wear to a minimum. A properly engineered live center is one of the fundamentals of setting up a job and requires a specialist's experience . . . standard shanks with Morse taper carried in stock.

Send us your specifications and blueprints—We will see that your job is set up with the right LIVE CENTER—prompt deliveries on high priorities.

STURDIMATIC TOOL COMPANY
5214 THIRD AVE. DETROIT, MICH.

HENDEY



PRODUCTION *for* WAR

Hendey lathes of whatever size or type have a definite place in the Production for War program. Be it tool or gage making, precision-production of parts entering into guns, tanks, ships of either air or sea, maintenance work; —all of which rank high in importance in the present conflict—they are squarely met and taken care of by a Hendey lathe. And remember, it has 68 years of manufacturing experience back of it.

THE HENDEY MACHINE COMPANY

TORRINGTON, CONN., U. S. A.

BOSTON • NEW YORK • ROCHESTER • DETROIT • CHICAGO

THE CENTRAL *Certified Accuracy* MICROMETER

Developed and Perfected by America's Only Makers of Micrometers Exclusively

All sizes up to 6 inches available with graduations by thousandths of an inch.

★

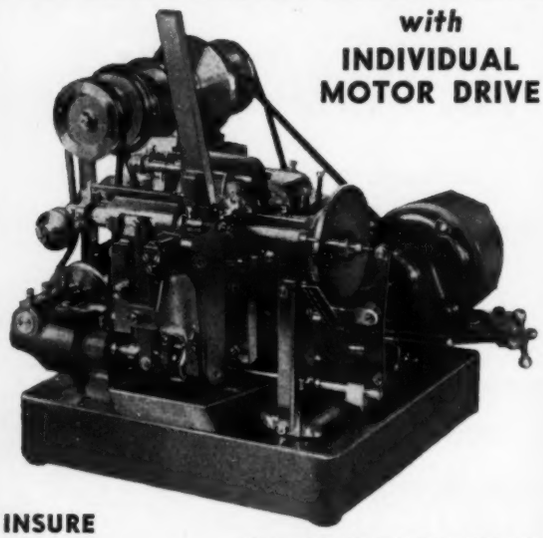
All sizes up to 4 inches are also available with graduations by ten thousandths of an inch.

THE CENTRAL TOOL CO.

Micrometers of Certified Accuracy

AUBURN · · · RHODE ISLAND

WALTHAM *MAGAZINE Fed* PINION CUTTERS *with* INDIVIDUAL MOTOR DRIVE



INSURE ***Great Accuracy Smoothness and Production. . . .***

Improved in design, Waltham Pinion Cutters achieve not only great accuracy and smoothness of work but also steps up production.

The magazine feed may be omitted and fine pitch gears up to 1½" diameter may be cut in a stack about 1" long.

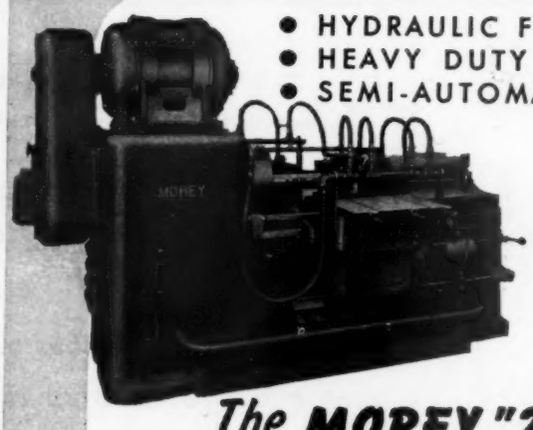
A countershaft for group drive can be supplied if preferred. Bench space requires 20"x22". Write for further details.

WALTHAM MACHINE WORKS

HIGH STREET — WALTHAM, MASS.

Suitable for 105 M.M. to 155 M.M. Shells

- HYDRAULIC FEED
- HEAVY DUTY
- SEMI-AUTOMATIC



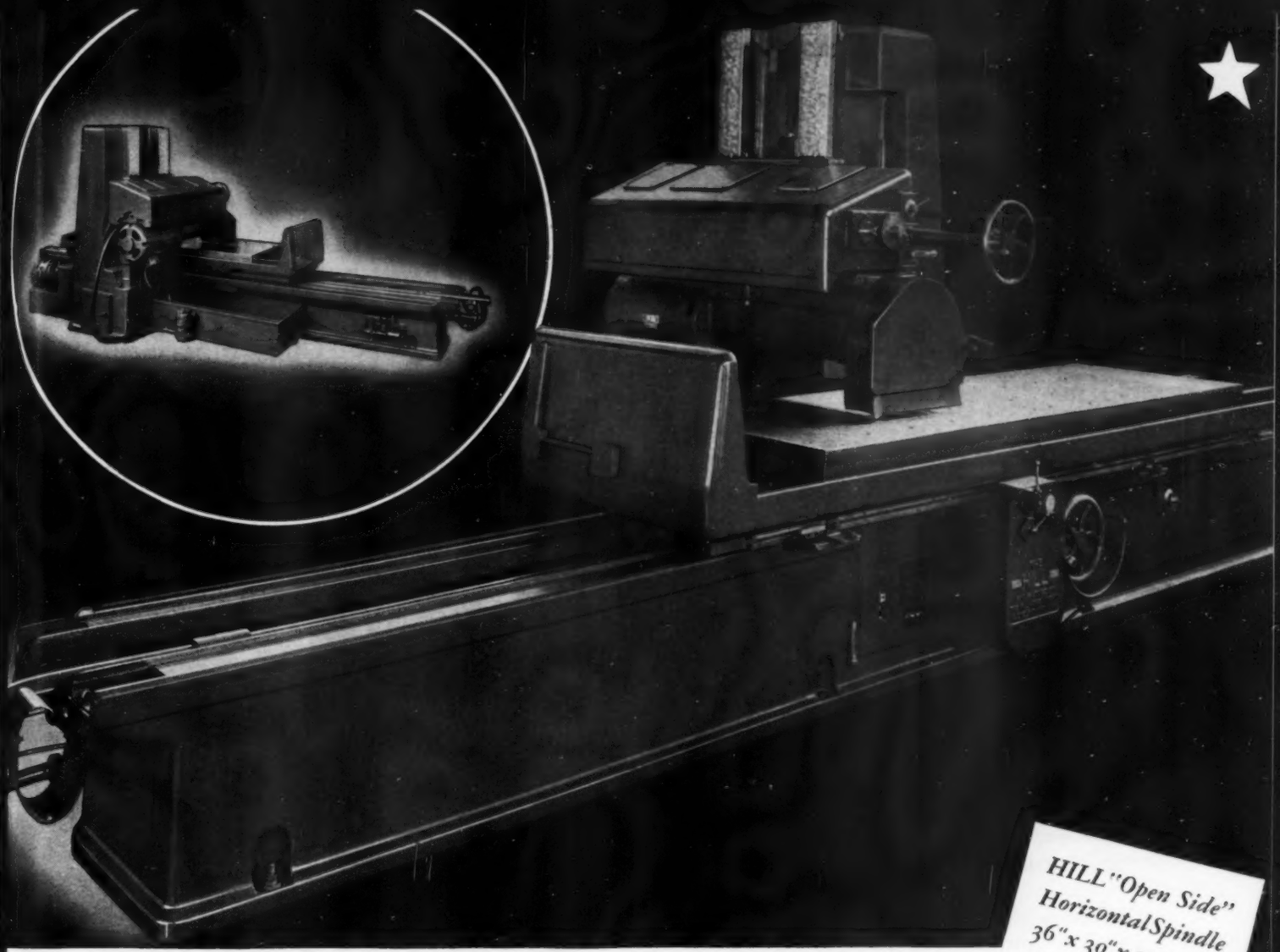
The MOREY "27" SHELL LATHE

Timken Tapered Roller Bearings for Main Spindle — All Others Anti-Friction

The HYDRAULIC FEED insures an almost effortless operation. Rigid enough to use carbide tools to their full capacity—entirely self-contained—no outside or auxiliary equipment required! Details in Circular 715—ask for it.

MOREY MACHINERY CO., INC

410 BROOME STREET • NEW YORK, N. Y.



HILL "Open Side" Horizontal Spindle 36" x 30" x 120" Hydraulic Surface Grinder — with HILL rectangular magnetic chuck in place

★ IT'S EFFICIENT
★ IT'S ACCURATE
★ IT'S ADAPTABLE

Users of HILL "Open Side" Hydraulic Surface Grinders consistently report production increases of 200 and 300% over previous methods of finishing. —That's real EFFICIENCY. . . . HILL Heavy Duty Hydraulic Grinders are working to tolerances of .0005" day after day, at speeds up to 100 feet per minute. —That's ACCURACY. . . . HILL Horizontal Grinders are ideal machines for special purpose grinding, production operations, or as general utility tools for grinding flat or irregular surfaces. —That's ADAPTABILITY. . . Table widths on HILL "Open Side" Horizontal Spindle Surface Grinders are 18", 24", 30" and 36". Table lengths range from five to twenty feet. Bulletin "A" gives you full and detailed information.

ALSO BUILT IN VERTICAL SPINDLE DESIGN

the HILL ACME CO.

A consolidation of two nationally known, fifty year old manufacturers:—The Hill Clutch Machine & Foundry Company . . . and The Acme Machinery Company
6400 BREAKWATER AVE., CLEVELAND, OHIO

IN THE AIRCRAFT INDUSTRY

THEY LOOK TO THE SPEED AND ACCURACY OF CAMPBELL CUTTING MACHINES TO HELP IN THEIR DRIVE TOWARD THE GREATEST PRODUCTION ACHIEVEMENT IN THE WORLD'S HISTORY

Abrasive Cutting Machines for bar stock up to 6" rounds, flat slabs, tubular and irregular shapes. Annealed or unannealed . . . Cut to micrometer-controlled lengths. No burning. Saves finishing operations.

Nibblers. Cut stock up to 72" wide and ½" thick. Clean, accurate cuts as operator holds work in two-hand grip.

Ask to have a Campbell Engineer show you what **CAMPBELL CUTTING MACHINES** will do for you. This implies no obligation whatever on your part.

ANDREW C. CAMPBELL DIVISION
BRIDGEPORT, CONNECTICUT

Cutting Airplane Sheet with a Campbell Nibbler
Cutting Slabstock with a Campbell Abrasive Cutting Machine
ACCO
AMERICAN CHAIN & CABLE COMPANY, Inc.
BRIDGEPORT • CONNECTICUT

L-W DIVIDING HEADS

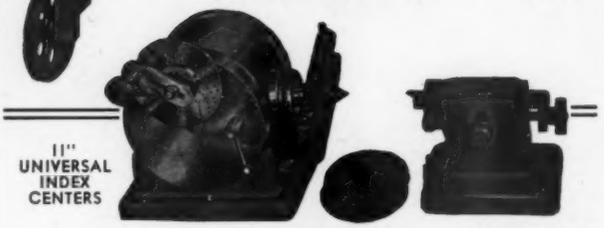
- Larger Worm Wheel
- Ball Bearing Worm Shaft
- Larger Spindle with full length tapered bearing.
- Threaded Spindle Nose
- No. 10 B&S Taper in Spindle
- Larger and heavier Headstock and Tailstock

Furnished In Right or Left Hand Models

SEND TODAY FOR FREE CATALOG

Also Mfr's of: MAGNETIC CHUCKS—DEMAGNETIZERS—MILLING MACHINE VISES—POWER HACK SAWS—LATHE CHUCKS.

MODEL AU—$194.65



MODEL BP—$128.55

Shipping Weight 125 lbs.

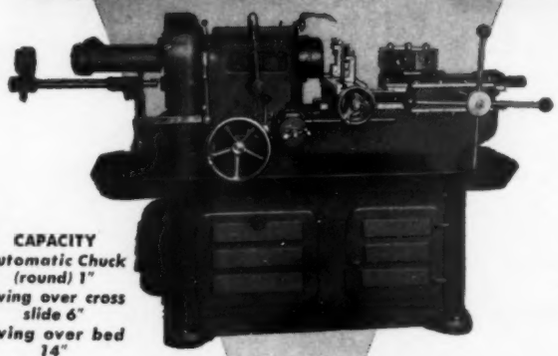
L-W CHUCK CO.

5 N. ST. CLAIR ST. TOLEDO, O.

For ECONOMY—for HIGH SPEED PRODUCTION

The MOREY 2G
Back-Geared
TURRET LATHE
Timken Bearing

Self-Locking Turret and Infinite Spindle Speeds



CAPACITY
Automatic Chuck (round) 1"
Swing over cross slide 6"
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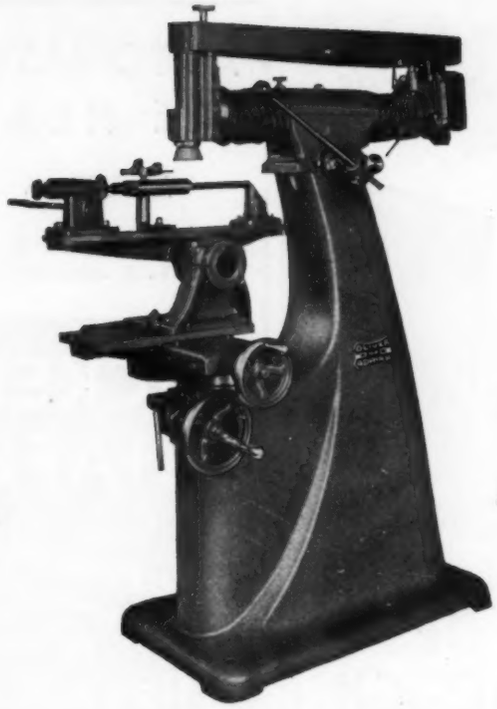

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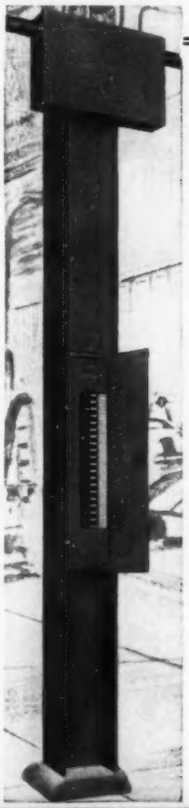

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2 SAW SHARPENER—Howe & Son, Inc., Hinsdale, N. H. 4-page illustrated folder describes in detail specifications, advantages and operation of automatic saw sharpener for reconditioning hack saws, band saws, circular rib saws, metal-slitting saws, etc.

3 PUNCH PRESSES—Leslie Welding Co., Chicago, Ill. 4-page illustrated folder has close-up shots and diagram of positive alignment hand-operated punch press. Lists advantages and shows type of work produced.

4 MILLERS—Wigglesworth Machine Tool Co., Cambridge, Mass. 4-page illustrated folder describes No. 3 small miller. Illustrates and describes parts and gives specifications.

5 PRESSES—Diebel Die & Mfg. Co., Chicago, Ill. 4-page illustrated folder describes automatic high-speed press with capacity of 500 strokes per min. Typical parts produced and rate for them shown.

6 STRAIGHTENING ATTACHMENTS AND PRESS—General Mfg. Co., Detroit, Mich. Sheet describes general hand screw straightening press with specifications and illustrations. Also, 4-page folder on general shaft straightening attachments. Gives user advantages and construction with complete list of specifications.

7 GRINDING MACHINES—Norton Co., Worcester, Mass. 37-page illustrated "The A.B.C. of O.D. Grinding" is complete manual on subject. Machines and proper care described in detail, selection of proper grinding wheels and mounts, operating tricks to increase production, etc. Handy charts of wheel recommendations for centerless and cylindrical grinding. Handy reference.

8 SHEET METAL WORKING—E. W. Bliss Co., Brooklyn, N. Y. 50-page plastic bound "Computations for Sheet Metal-Working Operations" describes in detail with diagrams, illustrations, formulas and charts, blanking and shearing, drawing and reducing, ironing, coining, sizing and forging, etc. Also mechanical press selection with much engineering data invaluable in these operations. Tables of properties of metals, etc.

9 MILLING MACHINES—H. Leach Machinery Co., Providence, R. I. 4-page folder on G & S vertical mill and jig borer, describes it with specifications, standards, and extra equipment available.

10 PRESSES—A. H. Nilson Machine Co., Bridgeport, Conn. 4-page illustrated folder on automatic press and four slide machine for swaging, stamping, piercing, blanking, and forming of coiled metal. Table of dimensions and typical parts made with it.

11 LATHE & GRINDERS—J. G. Blount Co., Everett, Mass. Data sheets describe unit type—alternating current, ½ hp. motor headstock lathe and pattern-makers lathe with specifications. Sheet on Model F 20-in. wet tool grinder with features, dimensions and specifications.

12 POWER PRESSES—Perkins Machine Co., Warren, Mass. Folder describes Power Press No. 355B with illustrations and descriptions, and No. 201B geared press.

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13 INTERNAL GRINDERS — Sav-Way Tool and Machining Co., Detroit, Mich. 4-page folder gives complete description and close-up illustrations of machine with specifications and details of operation.

14 FORM GRINDERS AND AUTOMATICS—Wickman Corp., Detroit, Mich. 4-page illustrated folder describes optical form grinder with advantages, operation and diagrams. Also 4-page illustrated folder on Swiss type high precision automatics, especially adapted to work on long slender parts. Gives specifications, dimensions, standard equipment and attachments furnished. Diagram shows complete operation with features.

TOOLS AND ACCESSORIES

15 SHELL GAGES—Federal Products Corp., Providence, R. I. 35-page catalog lists complete line of shell dial indicator inspection gages for cartridge cases, projectiles, primers, fuzes, bombs and small arms ammunition. Valuable reference, available to any plants manufacturing shells, small arms ammunition, bombs or other ordnance material.

16 MILLING FIXTURES—Auto Ordnance Corp., Bridgeport, Conn. Folder describes Thompson universal milling fixture, with illustrations showing use and operation.

17 LIVE CENTERS — Sturdimatic Tool Co., Detroit, Mich. 4-page illustrated folder describes Sturdimatic heavy-duty live centers for lathes, grinders, milling machines, screw machines, etc. Cut-away illustration and diagrams show construction and individual type centers available. Dimensions and features listed.

18 MILLING FIXTURES—Hartford Special Machinery Co., Hartford, Conn. 4-page illustrated folder on V-block milling machines for saving time on milling and boring set-ups. Illustrations and text show operation and advantages.

19 GAGE BLOCKS—Atometric Precision Gage Laboratories, Inc., Stamford, Conn. 4-page folder lists working sets and inspection sets with units included and prices for each. Handy for users.

20 COLD SAW—E. C. Atkins & Co., Indianapolis, Ind. 4-page illustrated folder on Atkins segmental cold saw with curled chip teeth has large illustrations of saw, showing operations and construction, type of cuts and chips and advantages.

21 DIAMOND TOOLS—J. K. Smit & Sons, Inc., New York, N. Y. 18-page illustrated booklet "Single Point Diamond Tools" describes truing and dressing of abrasive wheels, and gives table for determining diamond tool sizes, and other data. Describes types available and proper technique of use.

22 ROTARY FILES—C. L. Jarvis Co., Middletown, Conn. 8-page illustrated folder describes with large illustrations various types of rotary files available. Handy list.

23 MACHINE LEVELING JACKS—Enterprise Machine Parts Corp., Detroit, Mich. Folder describes advantages of Empco Machine Leveling jacks for doing better work and long life without bolting machine to floor. Describes installation and construction in detail, and includes price list.

24 CHUCKS—L. W. Chuck Company, Toledo, O. 12-page catalog illustrates, describes and gives specifications on line of lathe chucks, dividing heads, magnetic chucks, demagnetizers, milling machine vises, and power backsaws.

25 SHARPENING AND OIL STONES—Bay State Abrasive Products Co., Westboro, Mass. 8-page folder describes and lists complete line of products with specifications and prices. Useful catalog.

HEAT-TREATING AND WELDING

26 SPOT WELDER—Pier Equipment Mfg. Co., Benton Harbor, Mich. 12-page illustrated catalog 41, contains description of foot-operated and motor-driven automatic welders. Also describes Type 47 automatic weld timer for use with any size manually-operated welder.

27 FURNACES—Surface Combustion, Toledo, O. 4-page illustrated folder describes forced convection furnaces for faster war production. Illustrates development of furnaces from 1935 to now and number of types available.

PLANT SERVICE EQUIPMENT

28 MATERIALS HANDLING EQUIPMENT — Palmer-Shile Co., Detroit, Mich. 6-page illustrated folder "What's New in Materials Handling Equipment." Describes new developments such as cartridge cup tank, bomb fuse platform racks, etc. Specifications and prices.

PARTS AND MATERIALS

29 BRASS, BRONZE AND IRON ALLOYS —Cramp Brass and Iron Foundries, Philadelphia, Pa. 20-page illustrated engineering reference catalog on brass, bronze and iron alloys has details concerning P-M-G, a silicate bronze made without tin and composition, application and physical properties of 31 other alloys. Gives list of Cramp brass and iron products, effects of various elements on iron and discusses terms used in materials testing.

30 ELECTRIC MOTORS—Torq Electric Mfg. Co., Cleveland, O. 4-page illustrated folder on totally inclosed torque motors has cut-away illustrations, construction, and operations used, and illustrations of disassembly. Motor diagram and dimensions of all parts.

31 WELDING STAINLESS STEEL—Republic Steel Corp., Cleveland, O. 24-page illustrated booklet gives complete information on welding of stainless steel by principal commercial processes. Illustrated with welding samples and products, also proper and improper welded joint design. Valuable reference.

32 FOOT TREADLE SWITCH—Simonds Machine Co., Inc., Southbridge, Mass. 4-page illustrated folder on "Linemaster" foot treadle switch, illustrates each application, and advantage thru leaving both hands free. Specifications and prices.

33 CARE OF MOTORS—Allis-Chalmers, Milwaukee, Wis. Handbook entitled "A Guide to Wartime Care of Electric Motors" gives data on motor care under war conditions. Of value to war plant engineers and maintenance men, and for training new men.

34 MOTOR DRIVES—Drive-All Manufacturing Co., Detroit, Mich. 8-page illustrated folder on system of individual motor drives lists advantages, with cut-away illustrations and diagrams showing operation of units. Gives all necessary engineering data for mounting. Applications pictured, and list of typical users.

35 STEEL WEIGHT CALCULATOR—Allegheny Ludlum Steel Corp., Pittsburgh, Pa. Handy slide calculator, gives weight for tool, stainless, carbon and electrical steels. Valuable to user of these materials.

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for use with any standard make honing head

HONES CYLINDERS up to 24" in diameter . . . with STROKES from 20" to 72" . . .

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Aircraft parts . . . Ordnance parts . . . Diesel engines . . . Compressors . . . Pumps . . . Internal combustion engines . . . Steam cylinders, etc.

Speed up war work involving internal cylindrical surfaces by utilizing a HI-SPEED Honing Machine. When used with proper honing head of any standard make, the HI-SPEED machine produces accurate, straight, round, smooth bores—amazingly fast.

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All controls are located at the front of the machine at the operator's station . . . No ladders to climb . . . Stroke setting, hone withdrawal, short stroking at any point, changes in speed of reciprocation or rotation of the spindle made instantly from operator's station.

The HI-SPEED Honing Machine is made in 4 sizes, any one of which can be had with strokes up to 72"...Designed for use with any standard make of honing head.

Tell us your requirements—and our engineers will promptly furnish you with complete information, prices and early delivery dates.

Illustrated is No. 0 Machine equipped for 36" stroke with 80" under the spindle.

NOTE THESE SPECIFICATIONS:

	No. 0	No. 1	No. 2	No. 3
Model No.				
Stroke (standard)	20"	36"	48"	72"
Working Base Area (standard) Auxiliary Tables available	21" x 22"	31" x 31"	31" x 31"	48" x 54"
Height Under Spindle Nose (up) Added Height Available on Order.	48"	60"	75"	100"
Spindle Diameter	2⅝"	2⅝"	2½"	2⅝"
Spindle Speeds Through Gear Box	4	4	4	8
Main Drive Motor (standard)	7½ hp	10 hp	15 hp	20 hp
Coolant Pump Volume, Motor Driven	14 gpm	18 gpm	18 gpm	25 gpm
Maximum Bore possible to hone with standard spindle drive motor	10" Dia.	12" Dia.	16" Dia.	20" Dia.
Maximum Overall Diameter of Cylinder possible to place on standard base	18"	27"	27"	44"
Floor Area	44"x60"	60"x80"	60"x80"	60"x108"
Overall Height	11'6"	15'3"	18'3"	23'8"

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ORDINARY PRODUCTION SCHEDULE FOR FINISHED TOOL PARTS	PRODUCTION SCHEDULE WITH KENNAMETAL
1 ANNEAL	1 HARDEN
2 MACHINE	2 MACHINE
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You can save 2 steps in machining steels hardened as high as 550 Brinell, by using KENNAMETAL tools. The great hardness and strength of KENNAMETAL enable users to machine steels quickly and economically *after* hardening. In addition, the smoothly machined surface obtained with KENNAMETAL often eliminates grinding operations entirely.

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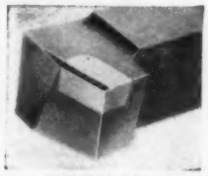

STYLE 21 TOOL

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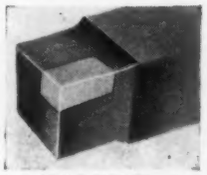

STYLE 3 TOOL

How to Take Care of Kennametal

Change Tools Regularly

Be sure you check tool wear carefully, so that tools can be changed before overwear. Over-dulling destroys accuracy of work and reduces the number of grinds possible during the life of the tool. Save time and tools by regular sharpening.

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Grinds 25 grids *in* *1 minute!*

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For Double Disc Grinding is the natural method on such work; on ball and roller bearing races, roller bearing rolls; on small gun parts; on bomb release triggers; on torpedo fuse plates; on airplane nuts — on any piece with opposed parallel faces, the areas of which are not too large. It's the natural method because it permits grinding both faces simultaneously, thus doubling production over single-surface grinding.

TAKE a look at the record on the job illustrated here; malleable iron grids, ground at 20 TO 25 PER MINUTE, holding the parts within .002" for parallelism, and .004" to .006" for uniformity.

For those parallel-surface jobs, investigate GARDNER-GRINDING

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STRIPPED TEETH: Too coarse a tooth on thin-walled section; too fine a blade used on soft stock; blade started at wrong angle; too much pressure.

BROKEN BLADE: Insufficient tension, allowing blade to twist and buckle; new blade in old cut; too much tension on blade (if blade breaks at end holes only); too coarse a blade for hard stock; wrong angle of blade or too much pressure (if blade breaks when starting cut).

DULLED TEETH: Speed too high; feed too light; teeth pointing in wrong direction; frame not lifting properly on return stroke; improper blade selected.

CROOKED CUT: Blade too loose; frame out of alignment; feed too heavy; set worn off teeth.

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Give your men this free 20-page booklet—packed with helpful tips and clear illustrations covering selection, use and care of hand and power blades, frames, and metal cutting band saws. Includes complete blade selection tables. Ideal for new, inexperienced men; helpful to old-timers as well. To speed work in your shop, write for free copies of "Metal Cutting" today.

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2639

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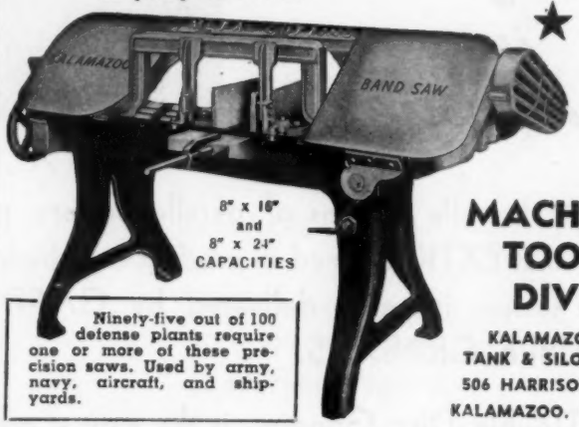

Ninety-five out of 100 defense plants require one or more of these precision saws. Used by army, navy, aircraft, and shipyards.

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The Ultra-Lap machine will finish your parts to a flatness of one light band or less . . . to a smoothness as low as one micro-inch R.M.S., any metal or material. Much faster, more uniform than hand method. Machine designed for you or we shall be pleased to lap your parts on a job basis. Ultra-Lap machines and service used by aircraft and many other war-time industries.
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GRINDING WHEELS

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*Fig. 732
one piece top
Drawer is
extra.

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SHOP EQUIPMENT

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HALLOWELL STOOLS Styles to meet every possible requirement, permitting correct posture and comfort. Welded angle legs and braces. Integral slide-easy dome feet will not catch, scratch or tear.

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* Fig. 1253

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is measured at the workhead. It goes up or down — with the quality of the tools. So give your operators MORSE TOOLS . . . maximum efficiency at the cutting head. Then you'll see why many plants have increased the capacity of their machine tools without buying new equipment.

MORSE

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HEAVY striking power in the field is made possible by high production machines such as this Davis & Thompson Planer Type Milling Machine. Designed and built especially for the job of producing vital tank parts at a speed far in excess of requirements, this machine is typical of the many Davis & Thompson special high production metal-working machines.

This machine is a 54" x 60" x 10' Planer Type Milling Machine with 25 HP Milling Head. The milling spindle has 3 speeds and 18 inches of quill feed. Head and table feed is by means of a fluid drive motor with final feed through a feed screw. Spindle speeds and quill feeds are selective. All movements are electrically controlled, all moving parts, wherever practical, are automatically lubricated.

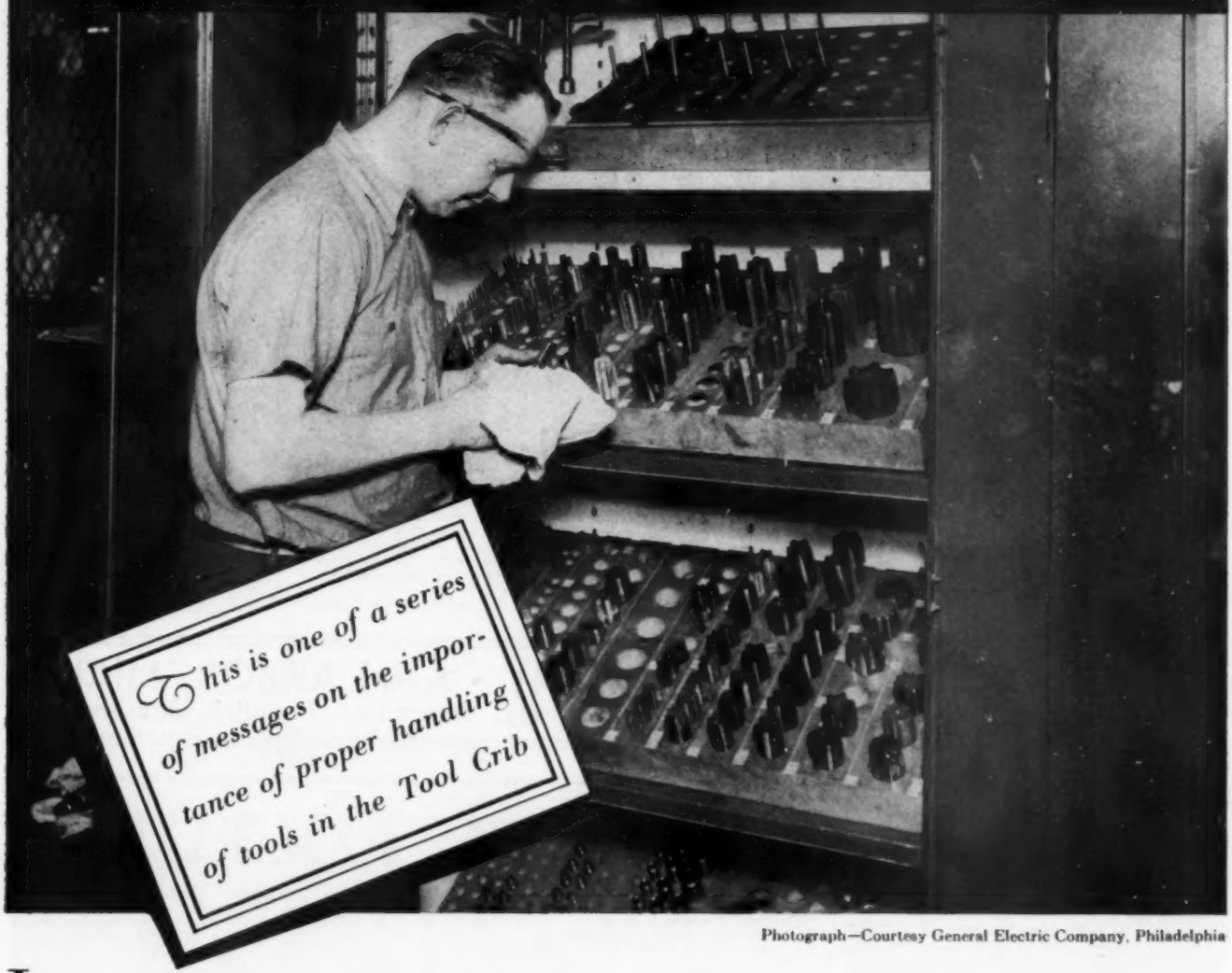
It can be furnished with double housing, with or without cross rail. Milling heads can be mounted on both columns and cross rail. Both table and head feeds can be engaged at the same time for profile milling. Heads can be mounted on swivel sub-bases for angular milling. Table feed is selective from one-half inch to 12 inches per minute, with a rapid traverse of 10 feet per minute.

Write for more complete details of this and other Davis & Thompson High Production Machines.

DAVIS & THOMPSON CO., MILWAUKEE, WIS., U. S. A.

DAVIS ROTOMATIC HIGH PRODUCTION MACHINERY

Tool Conservation begins in the Tool Crib



Photograph—Courtesy General Electric Company, Philadelphia

LONG, efficient tool life may be as much due to care in receiving, storing and handling in the Tool Crib as to proper use *out* on the job.

Here is an example of a carefully thought-out tool crib arrangement that pays substantial dividends to its plant in dollars and time saved. After use each Tap is carefully wiped clean of grit and chips before being restored to its proper place. The shank is placed in its individual recess, leaving the cutting edges free from chance blunting or chipping against other Taps.

This arrangement takes into consideration the size, shape and physical peculiarities of these tools to insure safety of storage, speed of locating and ease of handling.

GREENFIELD TAP AND DIE CORPORATION

GREENFIELD • MASSACHUSETTS

DETROIT PLANT: 5850 Second Boulevard

WAREHOUSES in New York, Chicago and Los Angeles

In Canada: GREENFIELD TAP AND DIE CORP. OF CANADA, LTD., GALT, ONT.

GTD GREENFIELD

TAPS · DIES · GAGES · TWIST DRILLS · REAMERS · SCREW PLATES · PIPE TOOLS

Buhr DRILL HEADS SIMILAR TO THIS ONE, ARE SPEEDING PRODUCTION IN VITAL WAR PLANTS

Here is but one example of the specialized engineering incorporated in BUHR - designed drill heads, now being used in the production of aircraft and armament. Want similar applications, so as to speed your work? Then send us your blueprints . . . . we'll make suggestions and recommendations on the use of BUHR-engineering and equipment.

A 40-spindle BUHR drilling and reaming head, designed for drilling and reaming all holes in aircraft motor cylinder head. Spindles have provision for vertical adjustment to lengthen drills. Oil pump gives positive lubrication at all times.

BUHR MACHINE TOOL COMPANY • ANN ARBOR, MICH.

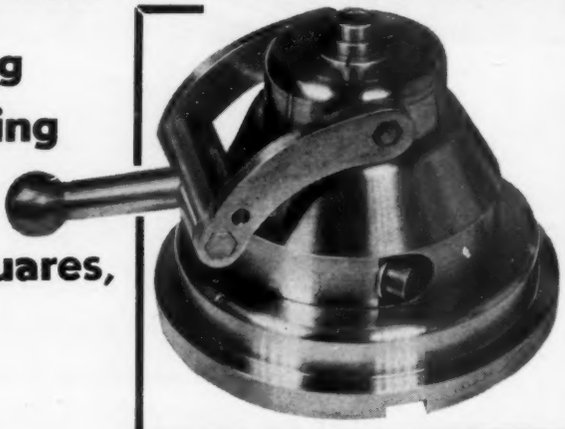
Specialists in Multiple Spindle Drilling, Boring, Reaming, Tapping Equipment

COLLET INDEX FIXTURE

For use on drill press. Can be mounted horizontally or vertically.

For use on any standard Milling Machine to mill slots, hexes, keyways, punches, taps, and many other operations.

- **For Holding and Indexing**
- **Makes Hexes, Squares, Slots and Holes**



One Handle to Open, Close and Index Collet.

Easy to set up. Indexes from 2 to 25.

No chip trouble.

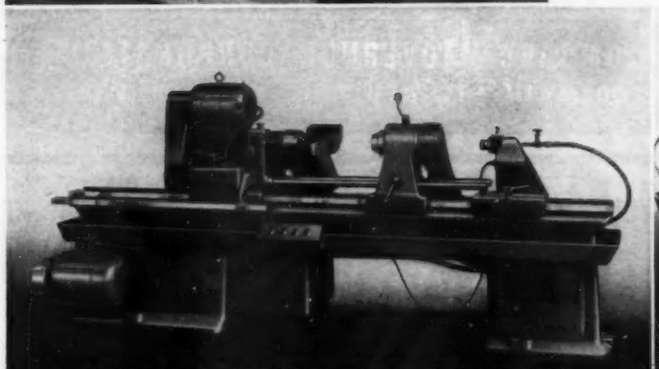
Two sizes—1" and 2".

ZAGAR TOOL INC. 23885 Lakeland Blvd. **CLEVELAND, OHIO**

W. F. & JOHN BARNES GUN BARREL MACHINES

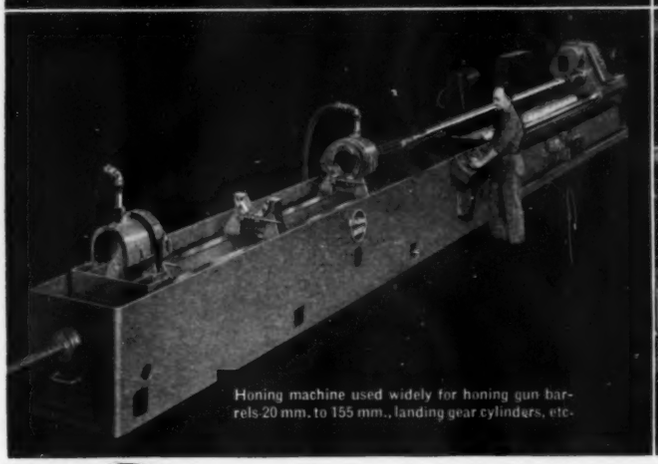
Six-spindle vertical rifle barrel drilling machine for .30 and .50 calibre rifle barrels.

Six-spindle vertical deep hole drilling machine for drilling 20 mm. gun tubes from solid.



Single-spindle deep hole drilling machine for rifle barrels, aircraft parts such as shafts, gear blanks, non-symmetrical parts, etc. Capacity: Drilling from solid . . . 1" max. dia. Core drilling or reaming . . . 1-1/2" dia. Stroke — up to 48".

Two-spindle deep hole drilling machine for .30 and .50 calibre rifle barrels, non-symmetrical parts, diametrically balanced parts such as cam and crankshafts, boring bars, etc. Stroke — up to 48".



Honing machine used widely for honing gun barrels 20 mm. to 155 mm., landing gear cylinders, etc.

Two-spindle deep hole drilling, boring, and reaming machines. Capacities: — Drilling from solid — 1" to 5" dia. Stroke — up to 16'.

W.F.&JOHN BARNES

FREE ● **Descriptive literature on any of the machines shown here will be sent promptly upon request.**
New Free Guide for grinding .30 and .50 Calibre Rifle Drills by hand also available,— send for your copy today.

W. F. and JOHN BARNES

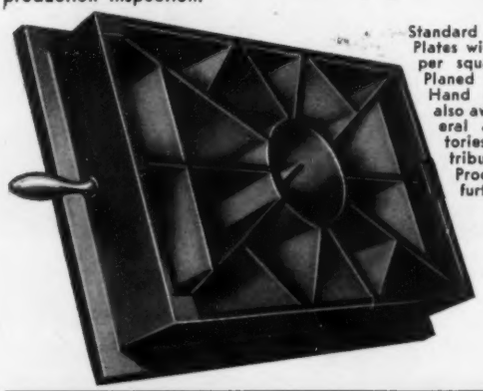
310 SOUTH WATER STREET • ROCKFORD, ILLINOIS, U.S.A.

Master

20-25 Bearings per Square Inch!

ACCURATE SURFACE PLATES

Designed for use where extreme surface accuracy is required, slow careful hand scraping by craftsmen produces this exceptionally high degree of precision in Lombard Master Accurate Surface Plates. Heavy ribbing and three point suspension insures maintenance of their extreme accuracy indefinitely. Ideal for general shop or first piece production inspection.



Standard Scraped Surface Plates with 12-15 bearings per square inch and Planed Surface and Hand Lapping Plates also available . . . Several attractive territories open for distribution of Lombard Products. Write for further information.

Made of close grained, semi-steel type iron under rigidly supervised control, these plates are given special heat treatment to relieve casting and machining stress. Construction is extra rigid and heavy. Prompt deliveries can be made in twenty stock sizes, from 14" x 18" to 48" x 96". Write for full details.

LOMBARD GOVERNOR CORPORATION
200 MAIN ST. ASHLAND, MASS. U. S. A.

WALKER MAGNETIC CHUCKS there's a WALKER for YOUR needs

No. 618 Bar-Pole Magnetic Chuck

Universal Swiveling Magnetic Chuck

You are sure to find the magnetic chuck that will exactly fit your requirements when you come to Walker. There's no guesswork because Walker makes all types and sizes, including Rectangular, Swiveling, Vertical Face and Rotary designs.

Then, too, you are assured of having magnetic chucks that are the product of long, specialized experience — chucks that are designed and built right for the specific service intended.

If you need special chucks for special purposes, Walker can supply them promptly and at reasonable prices.

You'll save time and money by specifying "Walker" on your next magnetic chuck order.

Style "D" Face Plate "Concentric Gap" Type

FULL DETAILS ON REQUEST

Ask for circular W-4

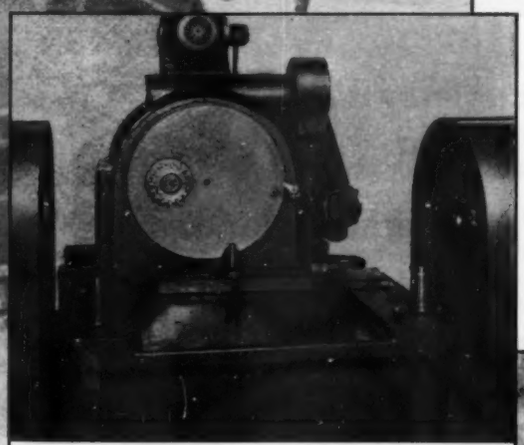
O.S. WALKER CO. INC. WORCESTER, MASS.

Conserve Man Power today . . .

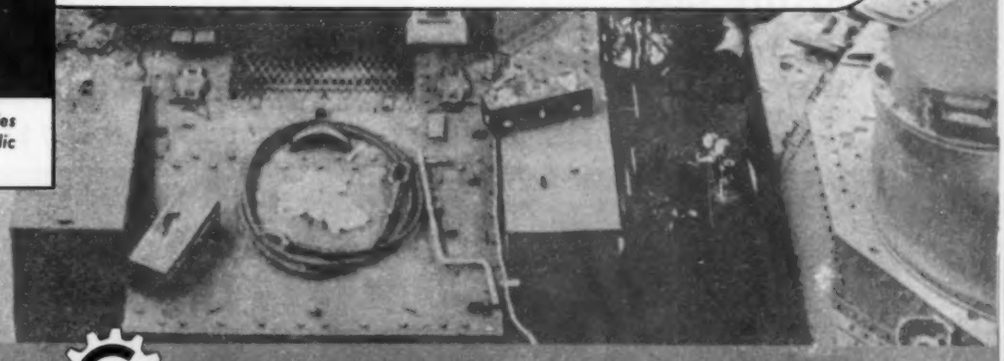
WITH CROSS SPECIAL MACHINES

CROSS 3 WAY *Milling Machine*

Demand for greater volume cannot be satisfied with the lone expedient of additional man hours. Manufacturers who were forced to improvise for a quick start are now increasing production with special machines that consolidate many operations. Cross analyzes manufacturing problems, develops new methods, engineers and produces special machines for doing better work faster. A typical application: the Cross 3-way profile miller which simultaneously finishes three faces on tank transmission housings with improved accuracy and saves 6 man hours per piece.



Cutter spindles are mounted in large circular cradles that oscillate in synchronized relation with hydraulic cross feed of the heads.



PHOTOGRAPH FROM PRESS ASSOCIATION, INC.

CROSS GEAR & MACHINE CO.

Established in 1898

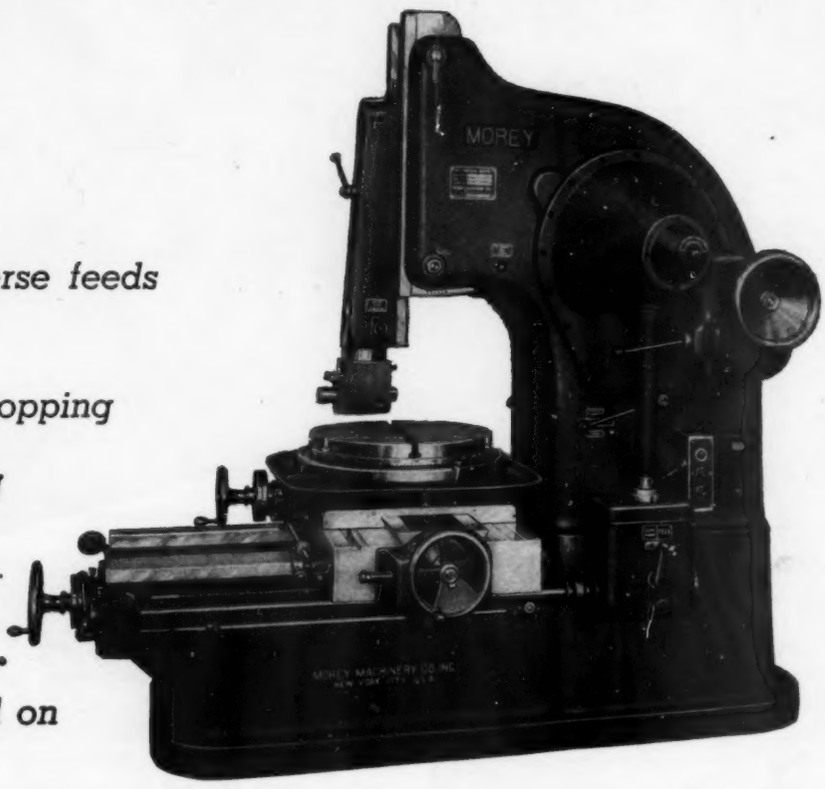
DETROIT, MICHIGAN, U.S.A.

S-1

EARLY DELIVERY

MOREY 8" VERTICAL SHAPER

EQUALLY EFFICIENT IN YOUR TOOL ROOM OR MANUFACTURING DEPARTMENT



FEATURES:

PRECISION

POWER *rapid traverse feeds in all directions*

BRAKES *for quick stopping*

BIJUR LUBRICATION

TIMKEN BEARINGS— *Bull gear mounted on Timken bearings* • *Roller table mounted on Timken bearings*

CUTTING STROKE *and* ***FEED*** *instantly available by single levers* • *Stroke immediately adjustable, automatically locked*

MODERN DESIGN—*easy to operate—built to highest standards* • *Finest materials*

POWERFUL—*yet finger-tip control throughout*

WE ALSO BUILD THIS SHAPER IN 12" AND 14" SIZES

ASK FOR CIRCULAR No. 726

DESIGNED AND BUILT BY

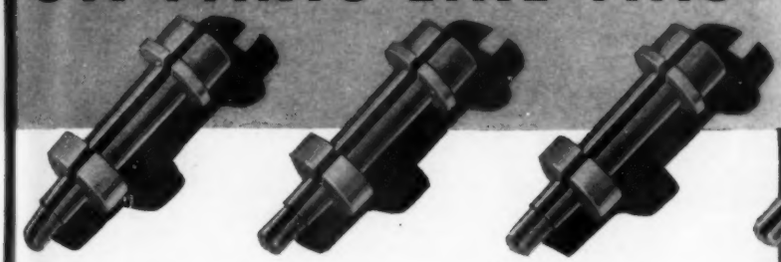
MOREY MACHINERY CO., INC

410 BROOME STREET · NEW YORK, N. Y.

Engineered Production

1800 Pieces an Hour

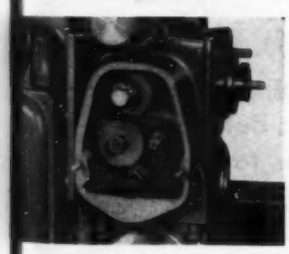
ON PARTS LIKE THIS



with Sundstrand No. 00 Rigidmil

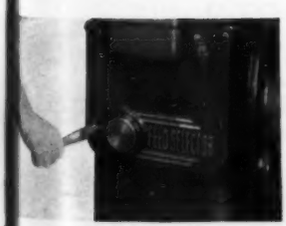
Sundstrand Engineered Production on No. 00 Hydraulic Rigidmil illustrated provides unusual table-cycle and special fixture . . . nets 1800 pieces an hour climb-milling slots in small brass parts. Slots are 0.057" wide ±0.002"; 0.281" deep ±0.001"; 1½" long. Same machine can be changed over quickly, with different fixtures and cutters, for high speed milling of other parts. Remarkable range of speeds, feeds, cycles, make standard Sundstrand Rigidmils best choice for war work and coming peacetime jobs.

Get High Output Milling Small Parts For Firearms, Fuses, Bombs, Instruments, Controls, Fuel Pumps, Similar Work



Speeds for Everything . . .

Patented high-ratio head of No. 00 Rigidmil is made in two speed ranges, each having 64 spindle speeds — Type A, 57 to 2416 r.p.m., and Type B, 85 to 3600 r.p.m. — for best milling in materials from steel to aluminum or magnesium.



Feeds for Everything . . .

Standard Sundstrand Hydraulic Feed Unit gives any desired feed rate from ½" a minute to 37" a minute, or optional range from 1¼" to 65" a minute. Simple adjustment provides fast feeds for roughing cuts, slow feeds for fine finish.

Cycles for Everything

Rapid traverse at 400 inches a minute and hydraulic feed gives fast, accurately controlled, one or two-way, continuous or semi-automatic table cycles; provides high production at a minimum of operator effort. Easily adjusted standard dogs establish all usual table-cycles. Sundstrand Engineered Production Department will recommend special dogs and cycles for unusual conditions. Diagram shows cycle used on above job; includes three standard dogs and one special.

Early Deliveries . . .

Standard No. 00 Hydraulic Rigidmils are available for early delivery. Write for full information.

GET FREE BOOK ➡

Get complete information about capacity, speeds, feeds, cycles and distinctive advantages of Sundstrand No. 00 Rigidmil by writing for booklet shown at right. Includes cycle diagrams and specifications. Ask for Bulletin 103.

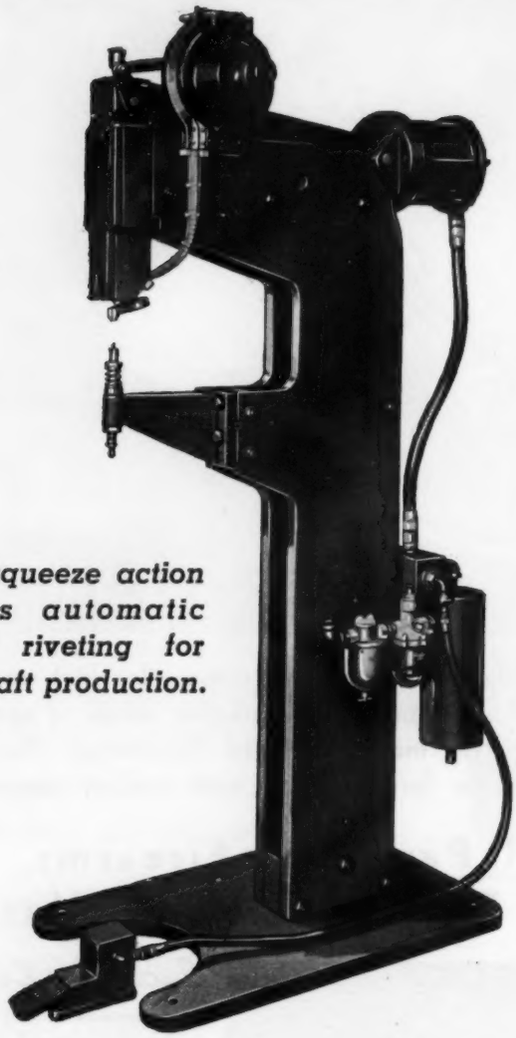
SUNDSTRAND MACHINE TOOL CO.

2533 ELEVENTH STREET, ROCKFORD, ILLINOIS, U. S. A.

TOMKINS-JOHNSON

Air Powered

RIVITOR



Air squeeze action plus automatic feed riveting for aircraft production.

It's fast—1600 riveted joints per hour with no manual rivet handling. This is an average figure. Increased or lowered production depends on the ease with which the work can be handled.

Write for Bulletin RP-1 to The Tomkins-Johnson Co., 615 N. Mechanic St., Jackson, Michigan

TOMKINS-JOHNSON

What causes poor threads?

H&G CHECK CHART

1. **Misalignment of machines.**
2. **Poor camming or start.**
3. **Drag in machine.**
4. **Condition of Die Head**
   (Loose front plates, dirt under front plates if tightened without cleaning, worn locking mechanism, bent shank, etc.)
5. **Improper chaser grind.**
6. **Dull chasers.**
7. **Machinability of Stock.**
8. **Improper cutting oil or poor volume or direction.**
9. **Speeds.**

Free—

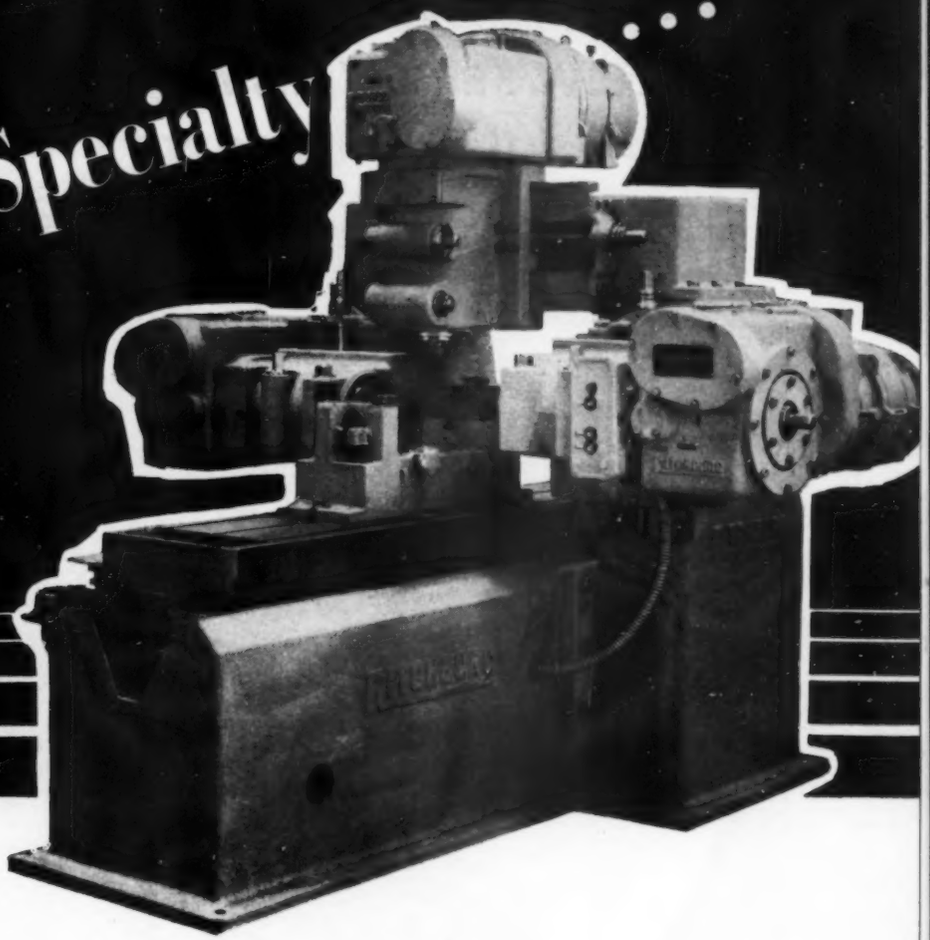
if you use H&G DIE HEADS

AS a part of our service we publish "DIE HEADLINES"—an informative bulletin packed with practical suggestions for improving production, quality and volume. Give description of machine and size and style of H&G Die Heads used with your request.

H&G DIE HEADS

The Eastern Machine Screw Corporation
20-40 Barclay Street, New Haven, Conn.

High Production Milling is a FITCHBURG Specialty ...



Fitchburg specializes on the designing and building of high production milling machines. Each machine is individually engineered for special operations.

The three-head milling machine shown here—for finishing six sides of Diesel fuel pump in two operations—solves a definite production problem and is a typical Fitchburg development for a specific application.

Fitchburg experience has resulted in the design of special machines that have increased production from 100 to 600% over former methods of milling the work. This experience is at your command to help you meet today's stepped up production schedules.

Consult Fitchburg on any phase of production milling and be assured of sound advice and capable service.

FITCHBURG ENGINEERING CORPORATION

FITCHBURG, MASSACHUSETTS

CLEVELAND *Open Side* PLANERS

"NEW SERIES" *displays advanced engineering as applied to modern planer construction*

• The New Series Cleveland Open Side Planers have been engineered to provide new improvements in design and construction that make for greater production—ease of operation—and lower costs and maintenance.

MODERN DEVELOPMENTS

Improved head design insuring greater rigidity for heavy cutting of high carbon steels.

Newly designed Rapid Traverse.

Centralized controls for Feed, Speed and Operating.

Duplex Helical Drive to Bull Gear for greater, smoother power.

"ALL ELECTRIC" CLEVELAND OPEN SIDE PLANER . . .

This modern "All Electric" Tool provides the utmost in automatic control, speed and adaptability to close tolerance, high production planer operations.

Fully illustrated bulletin describes in detail the functions, construction and advanced design of the "New Series" Cleveland Open Side Planers.

Built in 7 sizes from 26" x 26" to 72" x 72"

The Cleveland Planer

3148 - 3156
SUPERIOR AVE.
CLEVELAND
OHIO

AUTOMATIC INDEX MILLING *Multiplies* PRODUCTION!

THERE'S A KENT-OWENS REPRESENTATIVE NEAR YOU

BOSTON
General Machinery Corp.

BUFFALO
Don W. Patterson

CHICAGO
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DALLAS
Hamilton-Huster Machinery Co.

DAYTON
Gosiger Machinery Co.

DETROIT
A. C. Haberkorn Machinery Co.

GRAND RAPIDS
Joseph Monahan

HOUSTON
Oliver H. Van Horn Co., Inc.

INDIANAPOLIS
Oatis-Booth Machinery Co.

KANSAS CITY
Eichman Machinery Co.

LOS ANGELES
Eccles & Davies Machinery Company
Harron, Richard, & McCone

MILWAUKEE
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MOLINE
John J. Normoyle Co.

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F. F. Barber Machinery Co.

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Oliver H. Van Horn Co., Inc.

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Wilson Brown Company

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Calco Machinery Company

PITTSBURGH
Barney Machinery Co.

ROCHESTER
F. W. Schiefer Machinery Company

SAN FRANCISCO
C. F. Bulotti Machinery Co.

SEATTLE
Star Machinery Company

ST. LOUIS
Blackman & Nuetzel Machinery Company
Clarke Equipment Co.

SYRACUSE
J. F. Owens Machinery Co.

TORONTO
F. F. Barber Machinery Co.

WALKERVILLE
F. F. Barber Machinery Co.

● Shop men everywhere are calling on Kent-Owens for Automatic Index Milling Equipment.

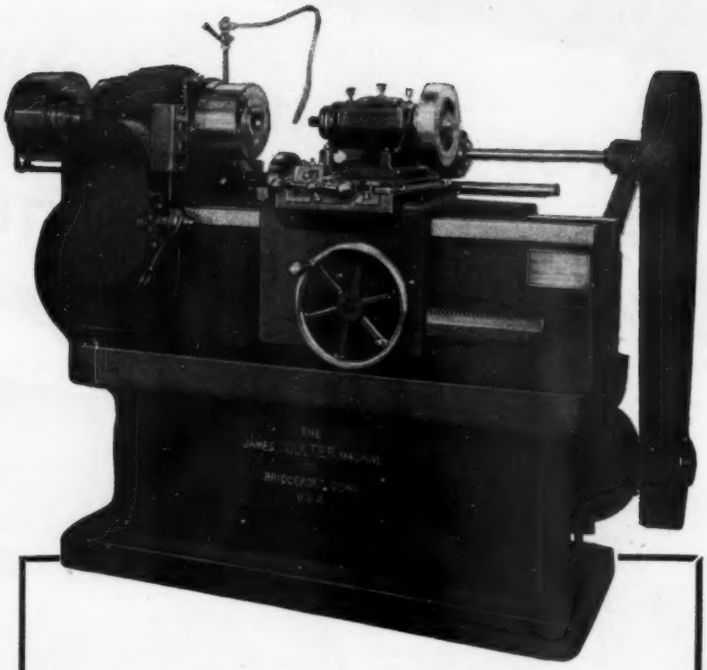
Kent-Owens has had wide experience in engineering a great variety of fixtures for this type of work.

If you have operations that lend themselves to automatic index milling, contact Kent-Owens to *multiply your production.*

Kent-Owens Machine Company, Toledo, Ohio.

Call on KENT-OWENS *for Milling Machines*

Keep Ahead of
DEFENSE DEMANDS
on the PRODUCTION of
EXTERNAL and INTERNAL
THREADS



The Coulter Type "H" Hob Thread Miller—modern in every detail of design and construction—handles high speed, accurate production of right or left hand threads. Any parts that can be held in ordinary chucks, air operated chucks, air operated collet chuck or special face plate fixture can be threaded on this machine.

Work holding spindle and cutter spindle are driven by individual motors through worm and gears. Speed changes to work spindle are accomplished by pick-off gears; cutter spindle speeds are controlled by variable motor sheave. All high speed shafts turn in anti-friction bearings.

Maximum external thread, 7"; minimum hole depends on smallest hob practical.

Send for Descriptive Bulletin giving full information.

The James COULTER *Machine Co.*
BRIDGEPORT · CONNECTICUT · U.S.A.

HANDLE YOUR SMALL PARTS MILLING ON THE NEW, FAST, VERSATILE NO. 3 HIGH SPEED WIGGLESWORTH

Smooth Auxiliary POWER FEED Assures HIGH QUALITY WORK . . .

While providing the usual features offered in conventional hand millers, the NEW NO. 3 WIGGLESWORTH also offers both hand or power longitudinal feed. Design of the auxiliary power feed is simple, rugged and powerful and assures that steady, smooth feed so necessary for fine finish without chatter marks. Furthermore, the versatility and ruggedness of this machine makes it particularly well suited to handling a wide range of small parts. Production milling can be handled on this machine also by equipping it with a special single "T" slot table in place of the standard three "T" slot table.

INVESTIGATE THESE ADVANCED FEATURES ALSO

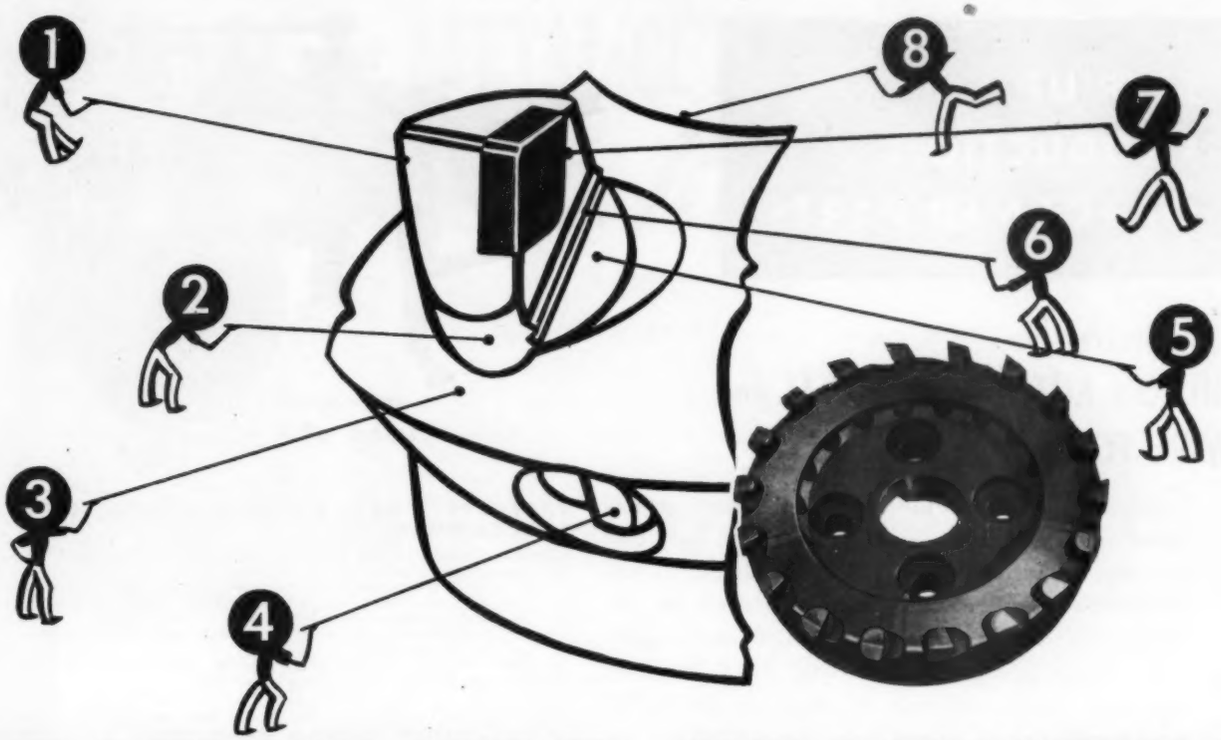
Timken bearing, hardened and ground spindle—accurate and rigid at all speeds.
Compact planetary gear, feed gear mechanism—providing proper reduction of spindle speeds for correct rates of feed to table.
Drive by V-belts from motor in base through an intermediary shaft to the spindle.

CONDENSED SPECIFICATIONS

Lever feed to table	10"	Speeds (6)—from 150 to 800 R.P.M.	
Crank or power feed to table	20"	Table working surface	7" x 20"
Transverse feed	5¼"	Taper in spindle	Standard No. 40

WRITE for illustrated bulletin giving detailed description and specifications.

WIGGLESWORTH MACHINE TOOL CO., 195 Bent St., Cambridge, Mass.



FEATURING FEATURES

OF LOVEJOY MILLING CUTTERS

Lovejoy inserted-tooth Milling Cutters have features that put them in a class with solid mills regarding strength and rigidity — and in a class by themselves regarding convenience, production and economy.

1 Rugged support for cutting edge of blade — whether it is solid High Speed Steel, Stellite, Rexalloy or Tungsten Carbide

2 Round hole in housing eliminates tendency to fracture under coarse feeds at high speeds.

3 Tough forged steel housing.

4 Positive locking device for blade makes it easy to compensate for wear and grinding.

5 Finely serrated blade and shoe guarantees minimum metal removed from blade for resharpened.

6 Serrations are on the front of the blade — not on the back, or locating side.

7 Lovejoy blades are interchangeable over a wide range of sizes. High Speed Steel, Cemented-Carbide, Stellite, and Rexalloy blades are carried in stock for immediate shipment.

8 Bores are precision ground concentric with the face of the cutter.

There is a complete line of Lovejoy positive-locking Milling Cutters to meet every requirement — details and specifications will be found in the Lovejoy Catalog. Send the coupon today!

LOVEJOY TOOL COMPANY, INC.
SPRINGFIELD, VERMONT, U. S. A.

Please mail me the 24-page Lovejoy catalog covering the full line of Lovejoy Mills.

NAME.....TITLE.....

COMPANY .....

STREET .....

CITY.....STATE.....

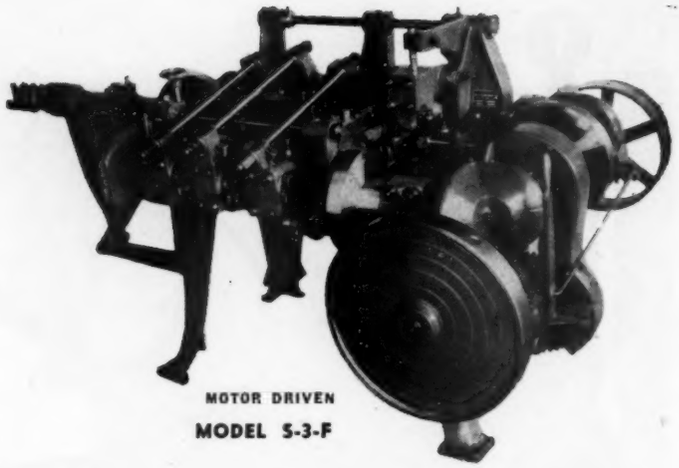
A.M.

STEP UP PRODUCTION OF FORMED PARTS

. . . with the

NILSON AUTOMATIC METAL and WIRE FORMING MACHINES

Today's requirements for higher efficiency, greater speed and products of greater uniformity and accuracy are met in the new NILSON RIBBON STOCK FORMING MACHINES. These machines are the achievement of over fifty years accumulated experience in designing and building metal forming machines. Careful selection of materials and skilled workmanship result in machines that are famous for long life and low maintenance.



MOTOR DRIVEN
MODEL S-3-F

FEATURES THAT CONTRIBUTE TO BETTER, FASTER WORK

Superior features of the NILSON four-slide forming machines are the result of long experience and include:

. . . open construction of press and forming tools.
. . . patented slide feed which has an independent cam-operated wire gripping device.
. . . transmission of power operating wire feed through a straight line.

Send for 4-page circular giving further information as well as detailed specifications of sizes and capacities.

•

We have been engaged in the design and production of special automatic machinery of high production capacity for over thirty years. We are prepared to render a complete service in connection with the design and production of automatic machinery of every description. Consult Nilson on your requirements.

THE A. H. NILSON MACHINE CO... *Bridgeport, Conn., U.S.A.*

THE NICHOLS HAND MILLER

» A modern, convenient machine for the volume production of accurate parts . . . .

In the "NICHOLS", the usual features of the hand miller have been combined with a ruggedness of design and construction which makes it a truly production machine tool offering high cutting speeds, maintained precision and long life. A wide variety of operations can be handled at top speed and reduced cost as compared with the same work produced on larger slower machines.

Because of its precision, great versatility and quick set-up, the Nichols Hand Miller is particularly adapted to tool room requirements. Its wide use in this class of service by leading manufacturers is evidence of its recognized value and suitability in meeting the requirements of modern shops.

•

Capacity: Longitudinal Feed, 10"; Transverse Feed, 7"; Vertical Feed of Knee, 13½"; Vertical Movement of Head, 4½", Working Surface of Table, 6½" x 21"; Spindle Speeds, 100, 200, 600 and 1200 R.P.M.

Send for Illustrated Bulletin giving Complete Information

W. H. NICHOLS & SONS *Waltham, Mass., U.S.A.*

These Low-Cost METAL-CUTTING BAND SAWS Can Help You *Right NOW*

When you are confronted with an urgent need for immediate increased production in connection with the U. S. armament program — check into the possibilities of using this 14-inch Delta metal-cutting band saw. It is ideal for cutting

- Aluminum Castings
- Aluminum Sheets
- Hard Cast Brass
- Soft Cast Brass
- Brass Sheets
- Brass Tubing
- Cast Iron
- Copper
- Metallic Hose
- Cold Rolled Steel
- Carbon Tool Steel
- Bronze & Manganese
- Drill Rods
- High Speed Steel
- Monel Metal
- Nickel Steel
- Iron Sheets & Bars
- Pipe
- Malleable Iron
- Babbitt
- Bakelite & Molded Plastics
- Asbestos & Felt
- Brake Linings
- Fibre & Mica
- Slate & Transite
- Hard Rubber

Will Help Speed up Production

There is no limit to the number of jobs you can find for this economical low-cost tool around the general tool and machine shop. And the few uses mentioned above scratch only the surface of the machine's adaptability. Die casters and molders of plastics find it indispensable for trimming work. The miter-gage groove in the table makes it easy to fit the machine with fixtures for cutting tubing, etc., on a production basis, and it can be fitted with rip gage for cutting strips from sheet metal. Once the machine is installed, there is no end to the number of jobs that are found for it!

Many Basic Advantages

This machine is not just another metal-cutting saw—but represents sound designing from the bottom up with many new basic features. Double trunnions provide rigid table mounting. Fully enclosed gear-drive, running in oil, is mounted directly on base of machine. Four metal-working speeds. Can be switched easily into high speed for soft materials. All wheels and shafts are carried on New Departure self-sealed ball bearings, insuring trouble-free performance for the entire life of the bearings. The guides, unlike those in ordinary machines, adjust independently of each other, are made with micrometer accuracy; and provide smooth, clean, accurate cutting.

OTHER DELTA LOW-COST MACHINES

Cut-Off Machine cuts speedily and to exact lengths a wide variety of materials. Priced at one half the usual cost of machines of this type.

A complete line of single and multiple spindle 14" and 17" drill presses in slow and high speed models.

Bench and Pedestal Grinders "that never forget their goggles"—the safest, most accurate and efficient grinders made.

Send for CATALOG

Send coupon below for latest Delta catalog giving full specifications and prices of Delta 14-inch Metal-Cutting Band Saw. Also prices and details on the complete line of Delta low-cost machines.

DELTA
MILWAUKEE

No. 887-C—
Metal-Cutting
Band Saw

THE DELTA MANUFACTURING COMPANY
608-G E. Vienna Avenue, Milwaukee, Wis.

Please send me catalog of Delta Machines, giving specifications and prices on Delta Metal-Cutting Band Saws. I am also interested in ☐ Delta Cut-Off Machines ☐ Delta Drill Presses ☐ Delta Grinders ☐ Delta Power Feed Drill Presses.

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Anti-aircraft guns, tanks, jeeps and hundreds of other kinds of ordnance equipment are being made with Niagara presses, shears and machines for sheet metal working. The complete range of well-graduated sizes and capacities provide the most productive and economical machines for shearing, blanking and forming operations.

Bulletins carrying complete specifications are available by writing Niagara Machine & Tool Works, Buffalo, N. Y. District Offices: General Motors Bldg., Detroit; Leader Bldg., Cleveland; 50 Church St., New York.

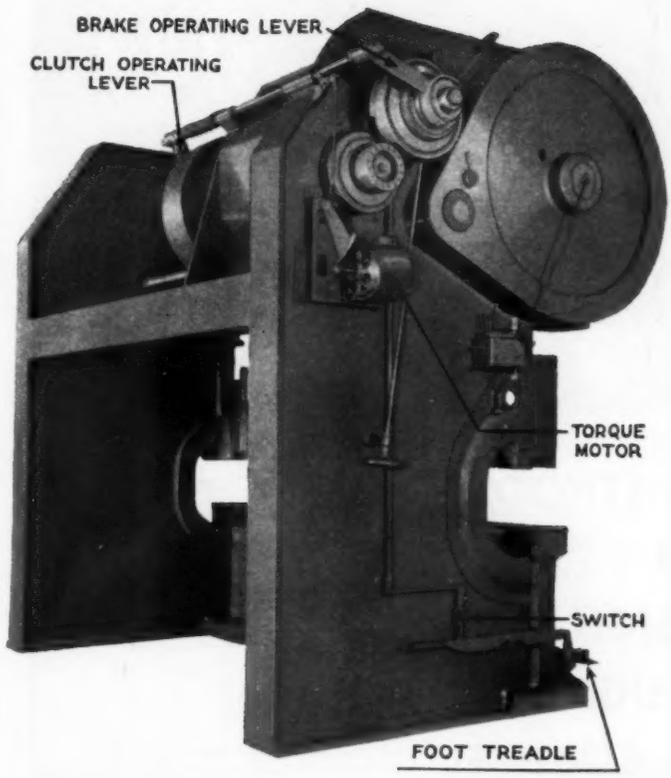
This machine is a Model M6-10 and is designed to bend 10 feet of ¾-inch steel plate between the end housings or plate 12 feet 6 inches wide by ⅜-inch thick over the entire length of bed and ram.

Electrically-operated

CLUTCH *and* BRAKE

...EASES OPERATION
...SPEEDS PRODUCTION

ANOTHER STEELWELD DEVELOPMENT



FEATURES that speed production, lower costs, ease the operator's work, increase machine versatility, etc., are continually being pioneered and introduced on Steelweld Presses.

Now the latest — an electrically-operated clutch and brake mechanism to reduce the fatigue of the press operator by eliminating the usual physical effort required to engage the clutch manually. As a result production can be stepped up considerably.

With the new mechanism it is no longer necessary to keep the foot treadle depressed in order that the clutch remain engaged, although this can be arranged if desirable. Snappy clutch and brake action is obtained which reduces the wear considerably because of decreased clutch and brake slippage.

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CATALOG No. 2002 gives complete construction and engineering details. Mail request for free copy on your company letterhead.

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MANUFACTURERS OF • CLEVELAND CRANES • CLEVELAND TRAMRAIL • STEELWELD BENDING PRESSES

STEELWELD
BENDING PRESSES

GENERAL SALES AGENTS: CYRIL BATH & CO., E. 70TH & MACHINERY AVE., CLEVELAND

Speed up Your Production!

HANDLE YOUR CUTTING-OFF OPERATIONS (3" and larger) ON THIS NEW MACHINE . . . . .

The Porter-McLeod Cold Metal Sawing Machine will definitely step-up your production and quickly pay for itself when you have to cut stock 3 inches and up.

An outstanding production cutting-off machine, with modern enclosed motor drive and centralized controls, the new 8" Porter-McLeod will handle single pieces or permit nesting of bars or shapes for cutting off multiple units simultaneously.

Feed of blade upward to the stock provides blade protection against riding or bumping. Support of blade near its rim prevents buckling and maintains accuracy of cutting. By pulling blades through the cut, large size stock can be cut with less power and with assurance of a straight cut. Standard feed of the machine is 3 inches per minute and is made by means of a friction disc which insures against blade breakage especially when coming in contact with hard spots in the stock being cut. Feed can be increased for cutting brass and other non-ferrous metals.

Regardless of the material to be cut, you can depend on this machine for the utmost in productive capacity, economy and speed.

The machine is driven by a 5 H.P. 1800 R.P.M. motor and is equipped with magnetic switch and push-button station. Detailed specifications available on request.

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OUR REPRESENTATIVE WILL GLADLY CALL AT YOUR REQUEST

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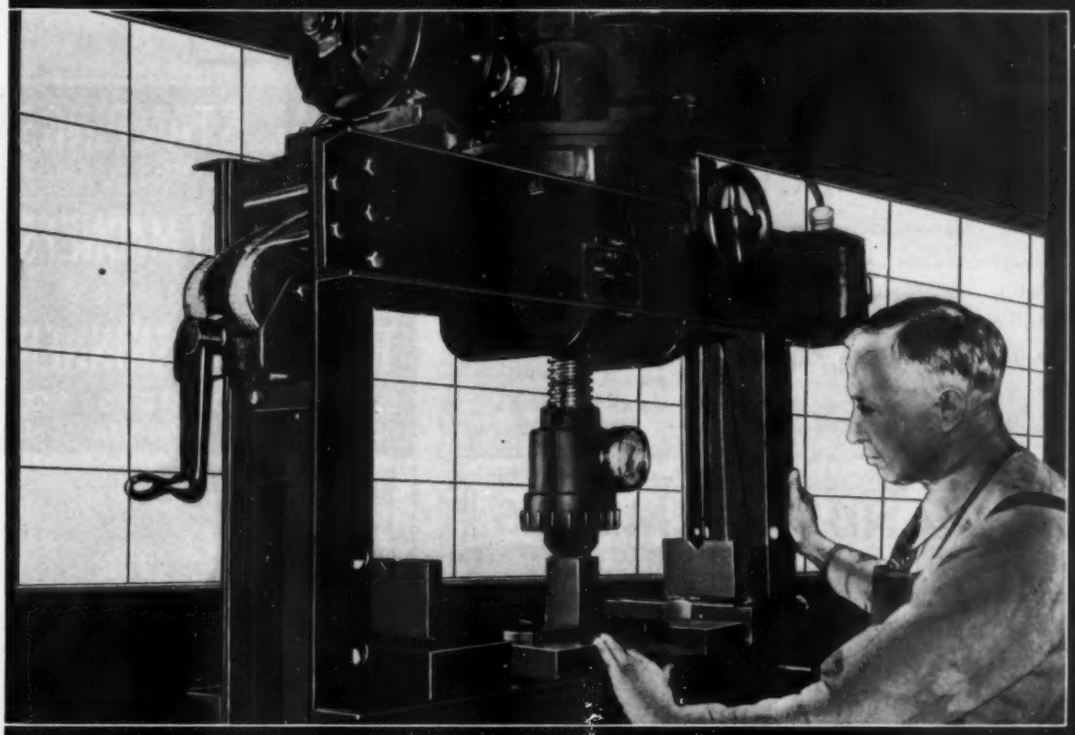
POWER + PLUS



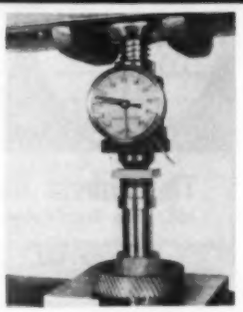
HYDRAULIC AND ELECTRIC PRESSES

40 and 60 ton models. Choice of ram travel and speeds. Moveable heads; adjustable bolster; foot-pedal switches; solenoid operated automatic magnetic brakes; reset switch and thermal relays protect motor against overloads. Fast-acting: from 0 to 50 tons pressure in 3 seconds!

$215 to $1205

Prompt Delivery! Priorities Can Be Had — Write Us.

Pre-Selected Automatic Pressure Control



Simply set gauge for desired pressure. Solenoid controls stop ram when pre-selected pressure is reached. It will even back the ram off the work automatically if you wish. This exclusive Lempco feature makes Power-Plus Presses ideal for production work.

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GENTLEMEN: Tell me the plant or shop nearest my place of business where I may see a Lempco Press.

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Advertisements on this and the following page are placed here by well-known concerns doing work on a contract basis. When you need assistance write to these established manufacturers.

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34 Automatic Screw Machines—Secondary Equipment: Milling, Drilling, Tapping, Threading—39 Punch Presses—Tool Room (well equipped)—Finishing: Parkerizing, Electroplating, Lacquering, Tumbling, Sand Blasting, Polishing, Buffing.

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We can make short or long runs in any metal. Our modern equipment and methods, backed by 50 years of experience, are your guarantee of satisfaction. We are also fully equipped to make

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TOOLS, DIES, JIGS, FIXTURES

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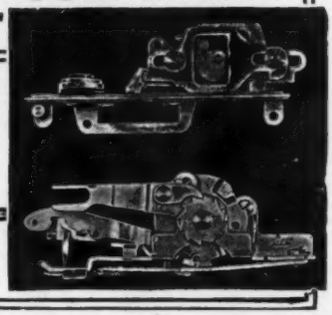

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MACHINISTS AND ENGINEERS
FIDELITY
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Need steel balls **for defense assemblies ?**

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ABBOTT BEARING BALLS

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Cylindrical Grinder 10"x54", Horizontal Boring Mill 2½" bar, Lathes, Milling Machines, Shapers, Drill Presses, Hand Screw Machines, Foot and Power Presses, Bench.

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NEED SUBCONTRACTORS?

If you can't find the facilities or services you need advertised here, we may have the company that can help you listed in our files. Write.

CONTRACT WORK DEPARTMENT
American Machinist, 330 W. 42nd St., N.Y.C.

MACHINE SHOP

Facilities include 9" South Bend Bench Lathe, #2 Brown & Sharpe Milling Machine, Drill Press and 8"x8" Shaper. The usual line of hand tools and equipment plus experienced workmenship assure your satisfaction. Your inquiries invited.

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For All Kinds of Castings, Large or Small
MATCH PLATE WORK A SPECIALTY

Put your pattern problems up to us—we will take care of them—ask the foundries about our work—they use our patterns every day.

GENERAL PATTERN WORKS
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JIGS, FIXTURES & GAGES
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DESIGNERS OF
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Prompt Service
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PUT YOUR IDLE CAPACITY TO WORK!

Hundreds of metal-working companies are finding profitable business today *outside* their regular lines.

You, too, can put your idle machines and equipment to good use by directing attention to them through American Machinist's CONTRACT WORK SECTION.

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Our Grey Iron Foundry, Structural and Machine Shops are at your disposal

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Medium Heavy

SPECIAL MACHINERY

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SUB-CONTRACT FACILITIES FOR

Hand screw machine products.

Engine and bench lathe, milling and drill press work.

Small sheet metal fabrications to closer than commercial tolerances.

Stampings.

We do our own tooling.

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36 years experience in metal fabrication.

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We can build machines and parts, special tools and fixtures of all kinds to your specifications and design. Skilled workmen and modern equipment are your guarantee of satisfaction. The design and building of wire and ribbon stock forming machines are our specialty.

We solicit your blueprints or samples for quotation. No obligation of course.

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GEAR and BELT GUARDS

Pressed Steel Louver Panels and Cover Plates

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GEST ENGINEERING & EQUIPMENT CO.

Ordnance and Defense Plant Equipment

Industrial Engineers

Jigs, Fixtures, Gages and Special Mach.

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● All types up to 6,000 lbs. Smooth Forged—Finished—Rough Turned, Hollow Bored and Heat Treated to Specifications. Crank Shafts—Shafting—Connecting Rods

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Engineers . . . Manufacturers

Sub-contract facilities for die castings and metal stampings

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WIRE AND METAL SPECIALTIES

In round, flat, square and special shaped wire in all metals.

LARGE PRODUCTION CAPACITY

Plating and finishing.

EASTERN TOOL & MFG. CO.

BLOOMFIELD, N. J.

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for

PROFITABLE SUB-CONTRACTS

For details, write

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American Machinist, 330 W. 42nd St., N.Y.C.

Automatic Screw Machine and Turret Lathe capacity available.

We do all kinds of press work, light and heavy fabrication, and assembly.

Box No. 300, American Machinist

330 W. 42nd St. New York City

SEARCHLIGHT SECTION

WANTED

Experienced man to take full charge of a Tool, Cutter and Gage Shop.

P-282, American Machinist
330 W. 42 St., New York City

U. S. CIVIL SERVICE

JUNIOR METALLURGISTS—Hundreds of appointments in the U. S. and elsewhere to be made for civilian war service at salaries up to $2,000.00 (including student appointments). No age limit—no written test. Write U. S. Civil Service Commission at Washington, D. C. for Circulator No. 254.

POSITIONS VACANT

These Positions Vacant advertisements are published subject to agreement by the advertisers not to consider applicants now employed on war work unless they obtain written release from present employer.

MECHANICAL DESIGNERS WANTED for design work on rifles and shotguns and on production equipment for same. Send complete outline of education and experience and salary wanted in first letter. Send also list of patents received, or other evidence of inventive ability. Permanent position for the right man. P-269, American Machinist, 330 W. 42nd St., New York, N. Y.

TOOL DESIGNERS—Routers—Production Control Men. Must have machine shop background and complete knowledge of modern machine tools. Experience on medium-heavy machinery valuable. P-287, American Machinist, 330 W. 42nd St., New York, N. Y.

CHIEF DRAFTSMAN WANTED: Man experienced particularly on design of screw machine tools, jigs, fixtures and gages, for precision work and to supervise draftsman. P-301, American Machinist, 330 W. 42nd St., New York N. Y.

A COMPETENT MACHINE shop general foreman by plant located in an industrial city in East Tennessee and doing general jobbing and building special machinery. Plant operates own foundry, machine shop, and pattern shop. Offers splendid opportunity for rapid advancement. None but a man of highest qualifications need apply. P-302, American Machinist, 520 N. Michigan Ave., Chicago, Ill.

CHIEF TOOL DESIGNER with large aircraft firm in the South. Must have had at least 12 years experience in aircraft tooling of which 6 years should be in tool design. Write application to P-307, American Machinist, 520 N. Michigan Ave., Chicago, Ill.

EMPLOYMENT SERVICE

SALARIED POSITIONS — $2,500 to $25,000. This advertising service of 32 years recognized standing negotiates for positions of calibre indicated. Procedure individualized to your personal requirements. Retaining fee protected by refund provision. Identity covered. If salary has been $2,500 or more send for details. R. W. Bixby, Inc. 266 Delward Bldg., Buffalo, N. Y.

POSITIONS WANTED

SWISS TYPE AUTOMATIC screw machines—set-up man 4 years experience with close work mostly aircraft instruments able to design. Cams. Draft 3A. 3 years mechanical engineering school desires position as foreman. Prefer Dry Climate. PW-304, American Machinist, 330 W. 42nd St., New York, N. Y.

PLANT MANAGER of wide experience on heavy machinery seeks a change, midwest location preferred. Engineering development would be of interest. Interview desired by appointment. Chicago or vicinity. PW-305, American Machinist, 520 N. Michigan Ave., Chicago, Ill.

SEARCHLIGHT SECTION
AMERICAN MACHINIST

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$5200 per YEAR

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Must have long experience with engine lathes, turret lathes, milling machines, automatic screw machines, hand screw machines. Ability to instruct and handle men essential. Full job security after wartime as we are continuing to manufacture our regular line for war needs. Well established firm located in New York City. Excellent living accommodations to be found near plant. Write stating qualifications, citizenship, etc.

P-290, American Machinist
330 W. 42nd St., New York City

TOOL ENGINEER—Twenty-five years experience in the mechanical field, including the design, checking and supervising of jigs and fixtures. Has recently operated own engineering office. Desires position as supervisor or engineer with small organization. Having a definite post war program. PW-306, American Machinist, 330 W. 42nd St., New York, N. Y.

EXECUTIVE with twenty-five years experience as Chief Engineer, Superintendent and Works Manager. Well versed on modern methods and equipment. Available Sept. 1st. PW-308, American Machinist, 330 W. 42nd St., New York, N. Y.

PRODUCTION PLANNING and tool engineer available. More than 20 years experience. Precision work, calling for better than average ability, excellent contacts with Naval and Army ordinance. Minimum salary. Considered $7500. Location unimportant. PW-309, American Machinist, 520 N. Michigan Ave., Chicago, Ill.

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EXCEPTIONAL OPPORTUNITY! Good salary . . . . reasonable traveling expenses . . . . attractive bonus on gross sales for six keen, aggressive men . . . . age thirty-two to forty . . . . thoroughly schooled and experienced in the Tool & Gage industry . . . . engineering background very desirable, but not essential.

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EXCEPTIONAL LINE! A superlative line of Gages, Tools and Fixtures . . . . recognized and accepted by country's leading precision manufacturers . . . . a line complete for direct sales representation.

EXCEPTIONAL TERRITORIES! Chicago, Detroit, Cleveland, New England, New York and Philadelphia. Agent and jobber territories available *only* outside of territories mentioned.

CAUTION! All applicants will be considered *only* on their *actual qualifications* and *background*, so if your qualifications do *not* meet with those as outlined above, be considerate of your time and ours, please do not reply.

State in detail, experience, education, age, salaries earned, draft status, citizenship, address, telephone number and other pertinent information. Reply

S. W. 310,
American Machinist,
520 N. Michigan Ave., Chicago, Ill.

POSTWAR PRODUCTS WANTED!

Long established, responsible manufacturing and sales organization seeks postwar products. Machinery, equipment or consumer goods. Confidential.

P. O. Box 502
Northwestern Station
DETROIT, MICHIGAN

SELLING OPPORTUNITIES

OFFERED—WANTED
Selling Agencies—Sales Executives Salesmen—Additional Lines

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MANUFACTURERS REPRESENTATIVE now selling to Eastern Plants and jobbers seeks additional line of nationally known metals, alloys, etc., whose eastern representation has been curtailed by the war. Well equipped offices. Dun & Bradstreet rating will be furnished. RA-303, American Machinist, 330 W. 42nd St., New York, N. Y.

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WORK WANTED — For advertisements of work wanted see names indexed under Contract Work in the Searchlight Section Index appearing on the page Facing the inside back cover.

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OFFICES AND SHOWROOMS AT — LONDON, COVENTRY, GLASGOW, MANCHESTER, BIRMINGHAM, SHEFFIELD, BRISTOL, NEWCASTLE, CALCUTTA, BOMBAY, SYDNEY, MELBOURNE, BUENOS AIRES

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METHODS — DESIGN — QUALITY
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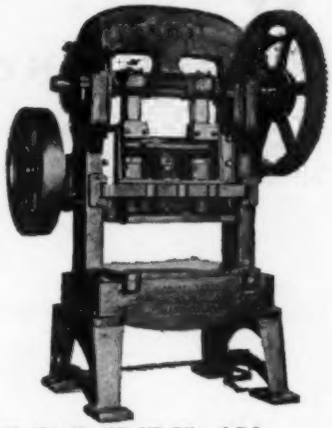

No. 18, 18C, 19, 19C, 20B Bliss, O.B.I.
No. 19 Truesdale OBI.
No. 4 Adriance OBI.
No. 46 MICHIGAN OBI.
No. 4 V & O—OBI.
No. 73½ BLISS S.S. Plain flywheel.
No. 4 Bliss Back Flywheel Geared.
No. 2 BLISS Back Flywheel Plain, (6).
No. 1—Bliss Back Flywheel Plain.
No. 3R—Marquette Geared, Motor Dr.
No. 15N BLISS, arr. Geared, Motor dr. (2).
No. 41 TOLEDO HORN PRESS, arr. Motor dr.
No. 6 Waterbury Backed Geared, Open Back.
No. 25N BLISS Geared, Motor dr.; (3).
No. 1 BLISS S.S. Toggle Press.
25 Ton Henry & Wright High Speed Press, dble. roll
No. 103S BLISS GANG DIE PRESS; Roll Feed.
No. 4½ BLISS three column Forging Press with Taper
6 Ton General Flexible Press.
12 Ton Fox Flexible Press.
400 lb. Chambersburg board Drop Hammer.
1500 lb. Chambersburg Steam Hammer, single leg.
50 lb. DuPont Blacksmith Hammer.
15 lb. Bradley upright Strap Hammer.
No. 30 BLISS ARCH PRESS, Plain.
No. 25 NIAGARA ARCH PRESS, Plain.
No. 71 Waterbury Coining Press 25 Tons.
No. 93D TOLEDO DBLE. CRANK GEARED S.S. PRESS, Welded Frame.
No. 75 Toledo Open Back Plain Flywheel Press.
No. 16 Bliss Horn Press, 3" stroke, Motor Driven.
No. 2 Niagara OBI; No. 0 V & O (3).
No. 3 American Can Co. OBI.
No. 53 Perkins Sprue Cutter.
No. 5 Middleditch Sprue Cutter.
No. 1—100 lb. Standard Automatic Drop Hammer.
No. 702—BLISS TRIMMING PRESSES (2) Flat.
No. 4 Waterbury open back, rigid bed, plain.
520 Ton Southwark Hydraulic with Laurie Pump.
SHERIDAN EMBOSSING PRESS, 24x36.
#7H Cleveland HORN PRESS back geared, 8" stroke with screw elevating cable. 42 tons.
#39B Bliss HORN PRESS.
#4 Bliss, double crank GEARED PRESS. 4" stroke, bed 32x28.

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15" HENDEY, Friction Drive (5), $450 ea.
20" CINCINNATI, Geared Crank, complete.
24" Stockbridge, Geared, Crank, Heavy. Cone dr.
20"x20"x24" N-B-P SHAPER-PLANER, Motor Dr.
12" New Haven Slotter; 32" Rotary Table.
7" Rhodes combination Shaper and Slotter, belt dr.

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4-Spindle Foot-Burt High Speed Ball Bearing with power feed to each spindle; automatic quick return, tight and loose pulley drive; 8" overhand No. 2 Morse Taper; table working surf. 14"x48".
1-Spindle Avey No. 3, 12" Overhang, No. 3 M.T. with Power feed; Ball Bearing.
1-Spindle Avey No. 2, 8" Overhang, No. 2 M.T. with Power Feed; Ball Bearing.
2-Spindle Avey No. 2, 8" overhang, No. 2 M.T. Plain Hand Feed; Ball Bearing.
3-Spindle Avey No. 2, 8" Overhang, No. 2 M.T. Plain Hand Feed; Ball Bearing.
2-Spindle Leland Gifford No. 2 M.T. 10" Overhang. Power feed to one Spindle.
2-Spindle KERN No. 2 M.T. 8" Overhang.
2-Sp. Henry & Wright, 8" Overhang, No. 2 M.T.
1-Sp. EDLUND No. 2B, 8" Overhang, No. 2 M.T.
1-SPINDLE ALLEN No. 2 M.T. 8" Overhang.
1-Spindle FOSDICK with TAPPING MECHANISM On SPINDLE No. 2 M.T. 8" Overhang.

DISC GRINDERS

Gardner No. 8—40" disc, 30" Ring Wheel, B.B. Belt Dr.
Gardner No. 4—20" Disc., 10" Ring Wheel, B.B. Belt Dr.
Badger No. 2—16" Disc, Double End, Univ. Tables, Belt.
Gardner No. 1—double end Disc, 12", B.B. belt dr.
GARDNER No. 14, Ball Bearing, double opposed, 20" discs.

20"x120" Landis Plain Cyliadrical Grinder Self Cont'd, Motor drive, Serial 8034.

GRINDERS—Cylindrical

20"x120" LANDIS Self-Contained, Motor dr.
12x36" CINCINNATI Plain, Arr. Motor Dr.

AUTOMATIC CHUCKING MACHINES

2—No. 24 New Britain type 5 spindle.
1—No. 23 New Britain type 5 spindle.
1—J&L HARTNESS AUTOMATIC CHUCKING LATHE; motor driven, 6"x12".

BROACHING MACHINE

Cincinnati SURFACE BROACHING MACHINE, model #5-54 duplex. New in 1937.

PUNCH & SHEARS

WICKES COMBINATION PUNCH AND SHEAR; MOTOR DRIVEN; 1¼" thru 1" Plate; Punching end 48" throat; Shearing end 36" throat; Continuous 6"x1" Plate.
LONG & ALLSTATER No. 2—24" Throat, arr. motor dr. Capacity 1" thru 1".
Niagara 36" foot Shear, 16 ga.
Kutscheid all steel 36"x16 ga. Foot Shear.
Pexto 48"x16 ga. Foot Shear.
Pittsburgh 36"x⅜" Plate Shear, no holddown.
UNITED ENGINEERING Plate Shear 42"x3/16 no holddown.
No. 216D NIAGARA RING AND CIRCLE SHEAR, Motor Dr.
No. 236 PEXTO CIRCLE SHEAR, SPD; 16 ga.
No. 132 BLISS 14 ga., 12" throat, Slitter.
No. 232 Bliss 12 ga., 18" throat, Slitter.
12'x¾" and 6'x¾" STAMCO MILL PACK SHEAR.
BLISS 24"x16 ga. POWER SHEAR—Perfect for Tin Plate.

COILING MACHINES

No. 1 and No. 2 SLEEPER & HARTLEY BX CABLE COILING MACHINES ⅝ and ½" cap. Last used for Speedometer cable. Complete.

KEY SEATER

No. 3½ BAKER 72"x3" Cap. immediate delivery.

HAND SCREW MACHINE

#2 BARDONS & OLIVER, Geared Friction Head, Power feed to Turret, 1" Cap. fitted with complete automatic chuck and air cylinder.

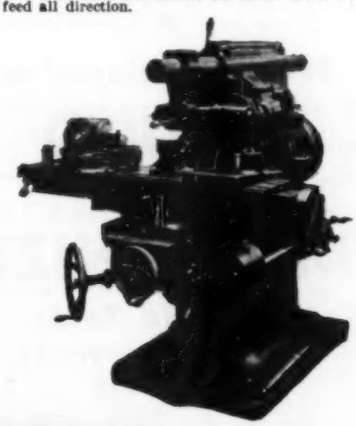
INTERNAL GRINDER

GREENFIELD No. 12, HYDRAULIC FEED, Motor Drive; Cap. swings 15" Grinds automatically ¾" to 5" dia.; 4" Deep; New in 1928.

MILLING MACHINES

No. 1 Cleveland, Motor Drive—$1,750.00. Coolant Pump, Motor $95.00 Extra. cap. 18" longit. feed 16" Vertical travel 8½" cross travel table working surface 8"x32"

No. 12 Pratt & Whitney Lincoln Production Miller.
No. 2 Pratt & Whitney Lincoln Production Mill.
1—3-H LeBlond Plain Miller, au. motor drive. Power feed all direction.

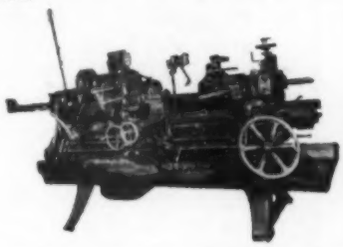


LATHES

42"x25' PUTNAM triple geared, 17'6" centers; Plain change gear, screw cutting.
36"x18' PRENTICE Lathe 9' Centers—Pl. chge. screw cutting, chuck and standard equipment.
22"x16' REED light Pattern, Pl. Change gear; 11' Centers, $750.
19x8 LEBLOND Production Turning Lathe
1—16"x8' American C.G. Lathe—au. M.D.
11"x4½' DAVIS pl. change screw cutting engine lathe; complete; $225.
10"x4' LOGAN (NEW) Lathes, Ball Bearing Spindle; ⅛" Collet capacity; arranged for motor drive; power cross feed; $225, f.o.b. factory; priority certificate required; shipment from stock.
7"x36" PRECISION BENCH LATHES — Hardinge, Sloan & Chase and others.
8"x108" FITCHBURG LO-SWING LATHE; SPD.
18"x12' HAMILTON pl. Change, Cone dr. chuck
11"x4' PRATT & WHITNEY TOOLMAKERS LATHE, Taper att.
16"x6' SOUTH BEND pl. Chge., Screw Cutting Engine Lathes (2).

TURRET LATHE

JONES & LAMSON 3x36 Double Spindle Very fine condition.



5" Bar BETTS Knee Type Horizontal Boring Mill, M.D.

COLD HEADERS
#22 Waterbury Farrell Cold Headers Dble stroke Solid Die also #11.

RADIAL DRILLS

DREISES 3' Arm. Plain Radial, Motorized; REBUILT —READY TO GO.
DREISES 4' Arm. Plain Radial, cone dr.

DIE CASTING MACHINES
3—MADISON-KIPP late model, 10"x12", 12"x14", 12"x16".

GEAR CUTTERS

No. 2 WHITON SPUR GEAR CUTTER, Auto.
36" Gould & Eberhart, "Victoria Model" perfect Cond.
48" Gould & EBERHART, Motor Driven; Complete; Perfect Cond.
No. 36B Gould & Eberhart Spur and Bevel Gear Cutter, Motor Dr.

HAMMOND 10 H.P. BUFFERS—8 months old. Motors in base, 3-60-220/440.

NEW LINES—WE SELL DREIS & KRUMP "CHICAGO" PRESS BRAKES AND BENDING BRAKES; STREINE POWER SQUARING SHEARS; BUFFALO DRILLS AND IRON WORKERS; CLEVELAND MILLING MACHINES; INDEX UNIVERSAL VERTICAL MILLERS; TROYKE ROTARY TABLES; L-W LATHE CHUCKS; INDEX HEADS; MAGNETIC CHUCKS AND HACK SAWS; VISES; OSWEGO MACHINISTS BENCH VISES; B-LINE MOTORS; VALLEY ELECTRIC GRINDERS; INQUIRIES INVITED.

FALK MACHINERY COMPANY

MACHINERY MERCHANTS

18 WARD ST., ROCHESTER, N.Y.

KEEP 'EM RUNNING!

REBUILT AND READY to SHIP

1—20" SELLERS slotter M.D. with 3/60/220 V motor.

1—4" BIGNALL-KEELER pipe machine, M.D. with 3/60/440 V motor

1—24" INGERSOLL cutter grinder, M.D. with 3/60/440 V motor

1—No. 1 MANVILLE cold header, single pulley drive

1—No. 1 CAMPBELL nibbling machine, M.D. with 3/60/220 V motor

ALSO AVAILABLE

2" B&K Pipe Threader, Landis Head
4" & 6" B&K Pipe Threaders, M.D.
4" LANDIS Pipe Threader
10" STANDARD Pipe Threader SPD
14" EC. & B. Pipe Threader
4" & 16" BAKER Tapping Machine
#8 GATERMAN 1/4 to 3/4 Tapper
#3 BEMENT Two Spindle Gang Drill
24" GLEASON Gear Former
32"x21' Heavy Plain Turning Lathes
48" TINDEL-MORRIS Crankshaft Lathe
1½" AJAX Bolt Header
2" ACME Upsetter
18'x12-Ga. Steel Press Brake
2" STOVER Pipe Bender

SIMMONS ENGINEERED Machine Tool REBUILDING

SIMMONS MACHINE TOOL CORP.
1759 North Broadway, Albany, N. Y.
N. Y. Office: 149 Broadway

USED MACHINE TOOLS
OFFERED BY
A TIME TESTED, RELIABLE COMPANY

BROACHES
No. 4 J. N. LaPointe

DRILLS
1 spdl. Henry & Wright
1 spdl. Leland-Gifford
2 spdl. Leland-Gifford Bench
2 spdl. Henry & Wright
4 spdl. Henry & Wright
4 spdl. Sigourney
4 spdl. Woodward & Rogers
6 spdl. Henry & Wright
2 spdl. Baker Cylinder Borer

GEAR CUTTERS
No. 4—48" Brown & Sharpe
No. 60 BM Gould & Eberhardt Bevel Gear Rougher (2)

GRINDERS
(See page 173—special advertisement Hill-Clarke Cylindrical Grinders)
22"x96" Norton Plain, M.D., Roll Forming Attachment
No. 40 Bryant Plunge Cut, Wide Wheel, Oscillating
No. 10 Lees-Bradner Spur Gear Grinder
No. 60 Heald Cylinder
1½" dia. New Yankee Drill Grinder

LATHES
3½"x60" Fitchburg Lo-Swing
No. 4 AC LeBlond Auto. Duplex Crankshaft

SLOTTERS
10" Newton

TURRET LATHES
No. 3-F Foster Fastermatic Chucking Machine, Platen Type (2)
No. 3-F Foster Fastermatic Chucking Machine, Indexing Type (2)

MISCELLANEOUS
60" Quickwork Rotary Shear
6" Saunders Pipe Machine
No. 4 Gaterman Tapper, 5/16" Cap.

HILL-CLARKE MACHINERY CO.
651 W. WASHINGTON BLVD. CHICAGO

Reconstruction Machine Tool Corp.
Rebuilding Plant
424-432 Bryant Ave., Bronx, N. Y.
Dayton 3-4246

We are equipped to
REBUILD
and
MODERNIZE
your old tools for today's tasks.

Send us full details of your problems—we will be glad to have one of our engineers inspect your machines and submit a quotation—without obligation on your part.

WRITE — WIRE — PHONE

GRINDERS

12x36 Pratt & Whitney, Surface.
2—Heald #60 Int. Cylinder.
2—Bryant #15 Internal.
Modern, 10x18 Univ. arranged for internal work.
8x30 Landis, Plain, m.d.
#3 Bryant Internal.

THE O'BRIEN MACHINERY CO.
OFFICE: 113 NORTH THIRD STREET
PHILADELPHIA, PA.

144 INCH GLEASON STRAIGHT BEVEL GEAR PLANER

CAPACITY: Spur Gears to 144" Dia. x 16" Face, Bevel Gears to 100" Dia. x 16" Face
Motor Driven with 220 Volt, D.C. 1000 to 1800 R.P.M. Motor. With Standard Equipment and Large Assortment of Cutting Tools.

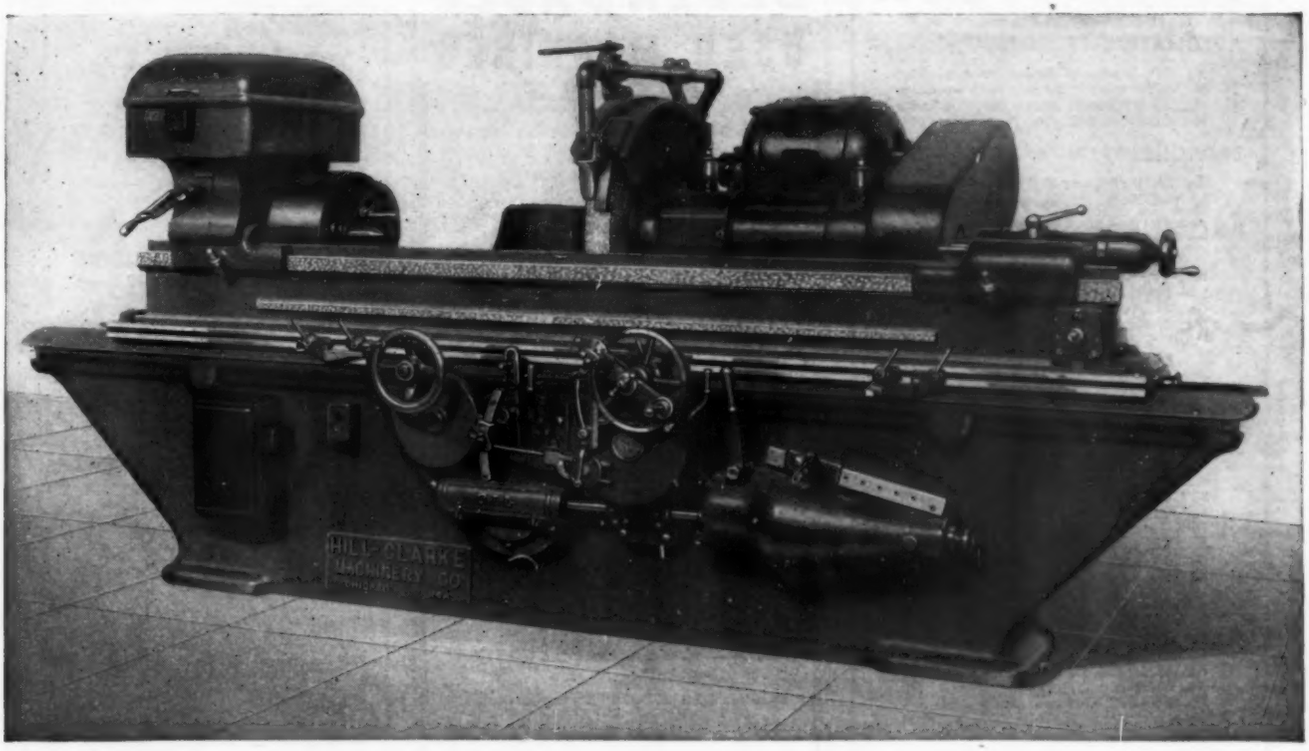
INDIANAPOLIS MACHINERY & SUPPLY CO.
INCORPORATED
1959-69 S. Meridian St., Indianapolis, Ind.

RADIAL DRILL

3' MUELLER, Gear Box single pulley drive, 9½" dia. round column, geared feeds, Tapping attachment, o'l grooved base, box table. Excellent condition.

ALEX ZEEVE & COMPANY
2269 Woolworth Building New York, N. Y.

Yours for Super Grinding!



HILL-CLARKE MODERNIZED CYLINDRICAL GRINDERS

give you a finish within a few micro-inches even when using standard grain free-cutting wheels. Contributing to this achievement is a patented multiple V-belt drive from a constant speed motor to the work spindle.

Throughout the machines there are refinements in design, fitting of components, minimized vibration which make possible extreme accuracy in all grinding operations. An accurately fitted wheel slide with cross feed screw mounted in ball bearings provides sensitive wheel control essential to duplicate work within close limits. For complete information, write for our illustrated catalog "Super Grinding."

SIZES

10 x 36	10 x 72	14 x 50	16 x 72
10 x 50	14 x 36	14 x 72	18-30 x 96

HILL-CLARKE MACHINERY CO.

651 WASHINGTON BOULEVARD, CHICAGO

...IN STOCK

AUTOMATICS

No. 515 National Acme, four spindle
No. 52 National Acme, four spindle
No. 53 National Acme, four spindle
¼" Cleveland Model A, single spindle

BROACHES

No. XB10 Oilgear Hydraulic Twin Spdl.
15 Ton Hercules Vertical

DRILLS

4' Prentice Radial
No. 1½ Foote Burt, 2 spindle
No. 15½ Foote Burt Fixed Center
No. 37 Natco Multiple Spindle
No. 1 Bausch, 8 spindle
Pratt & Whitney Gun Barrel, 2 spindle, m.d.

GEAR CUTTERS

No. 5 Cincinnati Automatic Gear Cutter
No. 3 Brown & Sharpe Automatic
No. 36 BM Gould & Eberhardt Rougher, three spindle
No. 6 Fellows Gear Shaper
96" Gleason Gear Planer
15" Gleason Spiral Bevel Generator
18" Gleason Gear Tester
No. 5A Lees-Bradner Gear Grinder
No. 10 Lees-Bradner Gear Grinder
30" Rochester Gear Tooth Rounder

GRINDERS

10"x20" Landis Cylindrical, hydraulic
12"x42" Landis Cylindrical
No. 55 Heald Cylinder
No. 60 Heald Cylinder
No. 24—53" Gardner Disc

LATHES

17"x8' Sidney, c.d.
18"x6' Lodge & Shipley, c.d.
18/24"x12' South Bend Gap, c.d.
26"x14' Niles Bement Pond, c.d.
17"x8' Wickes Production, c. d.
3½"x60' Fitchburg Lo-Swing, g.h.

TURRET LATHES

No. 3A Warner & Swasey, g.h.
No. 6A Potter & Johnston, g.h.
3x36 Jones & Lamson, g.h.
No. 9 Bardons & Oliver, c.d.

MILLS

No. 1½ B S Milwaukee, s.p.d. double o.a.
No. 1 Milwaukee Manufacturing, s.p.d.
No. 5C Becker, Vertical

MISCELLANEOUS

No. 3E Lees-Bradner Thread Miller, collet Type
⅝"x18' Nilson Wire Straightener Wicaco Oil Groover
2" Pratt & Whitney Duplex Spline Mill
No. 2 Davis Keyseater

PLANERS AND SHAPERS

32"x32"x10' New Haven Planer
18" Lodge & Davis Shaper
20" Rockford Shaper

TAPPERS

½" Rickert Shafer Radial

INDIANAPOLIS MACHINERY & SUPPLY CO., INC.

1959-69 South Meridian Street
INDIANAPOLIS, INDIANA

Eastern Branch:
44 WHITEHALL STREET, NEW YORK, N. Y.

MOREY
DEPENDABLE USED MACHINES

ROCKFORD #2 Horiz. Boring Mill—floor type—M.D.
G. & E. 48" Gear Cutter
WHITON No. 15 Auto. Gear Cutter
INGLE 12" Gear Tooth Rounders
GLEASON 37" Bevel Gear Planer
GLEASON 10" Spiral Bevel Gear Generator
GLEASON 6"-11"-18" Bevel Gear Generators
LEES BRADNER #5A Gear Generator
LANDIS 3½" Internal Hydraulic Race Grinder
LANDIS 16"x36" Plain Cyl. Grinder—M.D.
NORTON 14"x50" Plain Grinder—M. D.
HEALD No. 60 Internal Grinder
NORTON 16"x50" Crankshaft Grinder—M.D.
GARDNER No. 6 Dble. End BB Disc Grinder
P. & W. 6"x132" Thread Miller
AUTOMATIC MACHINE CO. 12x4' Threading Lathe
BRIDGEFORD 27"x10' Boring Lathe

BLANCHARD No. 16A Automatic Surface Grinder—Hand feed

P. & W. No. 12 Multi-Spindle Drill
NATCO C-13 Hyd. Multiple Spindle Drill
NATCO C-11C Multiple Spindle Drill
BLISS No. 31 Power Press
N.B.P. 400 ton Hyd. Wheel Press
ESPEN LUCAS No. 138 Cold Saw—Cap. 12" Rd.
NEWTON No. 197 & No. 200 Cold Saws
COCHRANE & BLY No. 5 Cold Saw
COULTER 2 spindle Diamond Borer—M.D.
LANDIS 4" Single Head Bolt Cutter
GRAY 30"x30"x8' Planer—2 heads on cross rail—M.D.
ACME 1" All Steel Upsetter
AJAX 3" All Steel Upsetter
SAUNDERS 8"-18" Pipe Threader
TREADWELL 12" Pipe Machine
KELLER E3 Auto. Profiler (Die Sinker)
ANDERSON Power Scraper
GISHOLT Precision Balancing Machine

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MOREY
MACHINERY CO., Inc.
410 BROOME ST., NEW YORK

EASTERN OFFERS

RADIAL DRILLS

2½' Avey Sensitive
3' American Sensitive
3' Carlton Sensitive
4' Hammond Jack Knife
4' Cincinnati Bickford, m.d.
6' Prentice, m.d.

UPRIGHT DRILLS

10", 20", 22", 22½", 26" 28", 42" W. F. & John Barnes
22" Barnes All Geared Self-Oiling
22", 24" Aurora
24" Hoefer
24" Rockford
25" Superior
24" Cincinnati Bickford, m.d., tapping attach.

GEAR CUTTERS & HOBBERS

No. 5A Lees-Bradner Gear Generator
No. 12 Barber-Colman Gear Hobber
16" Gould & Eberhardt
18" Gleason Straight Tooth Bevel Gear Generator
18" Gleason Bevel Gear Planer
30" Brainerd Gear Cutter
Gleason Spiral Bevel Gear Rougher
No. 1-26" Whiton Full Universal Spur & Bevel
No. 3-26", 3-36", 3 Heavy, 4-36", 4-48", 6-60", 6-72" Brown & Sharpe Auto. Spur Gear Cutters
Cross Gear Tooth Rounder
No. 3-26" Cincinnati Gear Cutter

PLAIN CYLINDRICAL GRINDERS

10x18" No. 14 Brown & Sharpe
10x24" Landis, m.d.
10x30" Queen City, m.d.
10x36" Landis Integral Cam, m.d.
10x36" Norton, m.d.
10x50" Norton, m.d.
10x52" Landis, m.d.
10x72" Norton, m.d.
12x36" Cincinnati, belt
12x36" Cincinnati, m.d.
12x36" Modern, belt
12x36" Modern, m.d.
12x42" Landis, belt
12x48" Modern, m.d.
18x72" Cincinnati Automotive Parts, m.d.
16x120" Landis, m.d.
26x96" Landis, m.d.

GRINDERS

No. 10 Bryant Internal
No. 1 Fraser Lapper
54" Bridgeport Knife
12x36" Cincinnati Universal
12x42" Modern Universal
No. 50, 55, 60, 65 Heald Cylinder
No. 4 Gardner Disc
No. 6 Diamond Disc
No. 20 Gardner Combination Disc and Roll
No. 120 Gardner Combination Disc
Gisholt Universal Tool
Gleason Cutter Grinder
Gould & Eberhardt Gear Cutter Grinder
Rockford Wet Emery
Springfield Wet Emery
Mitchell Eng. Co. type A1 Polishing
Cincinnati Valve Seat Grinder, 2 m.d.

HAMMERS

60 lb. Bradley Rubber Cushioned Helve
100 lb. Little Giant
800 lb. Bement Steam
1000 lb. Bement-Miles Single Frame Steam
1100 lb. Bement-Miles Single Frame Steam
2000 lb. Niles-Bement-Pond S.F. Steam
2500 lb. Bement-Miles S.F. Steam
Pettengell Bumping, belt

ENGINE LATHES

18" raised to 28"x10" Reed
18"x12' Barker
18"x16' Reed
20"x8' Fay-Scott
21"x12' Bradford
22"x13" Niles
22"x16' centers American 100 H.P. Input Super Lathe, with 100 H.P. D.C. variable speed motor and 6 smaller motors, weight 65,000 lbs.
22"x18' Niles
24"x8'6" Bridgeford
24"x10' Bridgeford
24"x10' Whitcomb-Blaisdell
24"x11' Chard
24"-16' Schumacher-Boye
30"x14' Hamilton

Many other machines in stock.
Send us your inquiries.

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MACHINERY CO.
1004 TENNESSEE AVE.
CINCINNATI, OHIO

GOOD USED MACHINERY

AIR COMPRESSORS

136′, 8″x8″ **Chicago Pneumatic Tool Co.**, type NSB.
136′ 8″x8″ **Ingersoll Rand**, type ERI.
550′, **National** 3-cylinder vertical
620′, 14″x8¾″x10″ **Sullivan**, class WJ3 angle compound
706′ 17″x9¾″x12″ **Sullivan**, class WJ3 angle compound
868′ 17″x10″x12″ **Chicago Pneumatic Tool Co.**, type OCB
1400′, 20″x12″x14″ **Sullivan**, class WJB

BULL DOZERS

Nos. 5, 6 and 29 **Williams & White**

BROACHES

No. 1 **LaPointe**, screw type
No. 2 **Standard** screw type broaching press
No. 3 **LaPointe of Hudson**, screw type
No. 3 **J. N. LaPointe** double screw type
No. 3 **American** high speed, rack type

DRILLS, UPRIGHT, GANG AND HEAVY DUTY

20″ **Excelsior** plain hand feed
20″ **Silver** plain hand feed
20″ **W. F. & J. Barnes** plain hand feed
21″ **Superior** plain hand or back geared power feed, tapping attachment
21″ **Cincinnati** plain hand feed
21″ **Cincinnati** sliding head
21″ **Cincinnati** direct geared mfg.
22″ **Aurora** sliding head
22″ **Barnes** sliding head, hand feed
22½″ **W. F. & J. Barnes** stationary head, back gears, power feed
22½″ **Mechanics** plain hand feed
24″ **Cincinnati Bickford** sliding head, back geared power feed
24″ **Cincinnati Drill Co.**, sliding head, power feed
25″ **W. F. & J. Barnes** stationary head, back gears, power feed
25″ **Superior** sliding head, back geared, power feed
26″ **W. F. & J. Barnes** sliding head, back geared, power feed
26″ **Bickford**, sliding head, back geared, power feed
26″ **Hoefer** sliding head, back gears, power feed tapping attachment
28″ **Aurora**, sliding sliding head, back gears, power feed
22½″ **W. F. & John Barns**, 4 spdl. hy. dy.
2⅜″ **Barnes Drill Co.**, hy. dy. camel back

DRILLS, MISCELLANEOUS

Nos. 15½, 15½F and 16 **Foote Burt** for Multiple heads
Garvin, Nos. 0 and 008, double end drilling and centering
Natco one and two-way lead screw tappers
Baker hydraulic, double end drill.
5 spindle **Detroit** automatic with fixtures
3 way **Foote Burt** for multiple heads
Avey motor driven unit heads, No. 2, ⅝″ capacity
No. 3 **Milholland** two way drills, motor drive
4″x12″ & 4″x72″ **Sundstrand** double end drilling and centering
1′ **Cleveland**, Model J, double end drilling, threading, pointing or turning
Type 8H **Natco** hyd. horizontal multiple
Barnes heavy duty vertical hydraulic for boring & drilling

FURNACES

No 420 **Standard Fuel Engineering Co.**
No. 0 **Stewart** crucible
21″x32″x21″ **Surface Combustion Co.** heat treating
45″x46″x45″ heating for forge work
No. 515 **Standard Fuel Engineering Co.** pot type
No. 1D **American** rotary carburizing

GEAR CUTTERS

No. 18H **Gould & Eberhardt** universal gear hobber
8″x10″ No. 1 **Lees Bradner** production hobber
14″x8″ No. 5A **Lees Bradner** universal hobbers
26″x8″ No. 3 **Brown & Sharpe** auto spur.
36″x6″ **Gould & Eberhardt** spur gear cutter
48″x10″ No. 4 **Brown & Sharpe** automatic spur
15″ **Gleason** bevel gear quencher
Gleason circular finishing cutters, without blades
National Tool Co. (Cleveland) Model B gear and gear shaper cutter checking machine
Lipe gear tooth chamfering machine, double spindle
No. 3 **Barber Colman** gear hobber
18″ **Gleason** bevel gear generator

ROLLS

No. 1A **Ajax** taper forging, motor drive.
54″ **McKay** 19 roll sheet leveler
Bay City bending rolls, 4″x3/16″

SHEARS

⅝″x6″ No. 54 **Hendley & Whittemore**, punch, shear, and rod cutter with angle shear attachment
No. 1 **Long & Allstatter** alligator
Lewis alligator, 10″ blade
Newbold guillotine, 2″ capacity
No. O-15 **Stanley Uni-shear**
36″x18 ga. Toledo No. 418 B.
No. 1 B **Campbell Nibbler**, 3/16″x24″
18″ **Pels** all steel beam shear
10 KVA **"DYER"** Topeka 220 v. new

WELDERS

12 KVA **American Electric Fusion**, type BW 16.
17 KVA **Thomson Gibb**, 440 V., spot
20 KVA **Agnew**, type 10D, 440 V., spot
20 KVA **Taylor**, 440 V., spot, 14″ reach
20 KW **Taylor Moesta**, 440 V., portable gun type spot
20 KW **National**, spot, 28″ reach, 220 Volt
23 KVA **Winfield**, 440 V., spot
25 KW **Winfield**, spot, 220 V.
25 KW **Winfield**, 220 V., butt
30 KVA **Thomson**, 220 V., butt
35 KW **Federal**, type 60, 440 V., automatic upset butt
65 KW **Federal**, type 10A, 440 V., butt
150 KVA **American Electric Fusion**, type HJ 10, 440 volt, air operated multiple welder
150 KVA **Swift** flash butt welder, 440 Volt
375 KVA **Fisher "Autocrat"** press type.

MISCELLANEOUS

6A **Potter & Johnston** automatics
4′x¼″ **Cincinnati** press brake
36″ **Niles** car wheel vertical borer
22″, 24″ & 28″ **Steinle** turret lathes
5″ **Barrett** horizontal mill
4″ **Beeman & Smith** double end boring mill
36″ **Morton** draw cut shaper
12″ **Dill** slotter.
2″ No. 6 **Langelier** swager
Excello 9 spindle borer.
Blakeslee and conveyor spray type degreasers
AC die casting machine
No. 61AA **Bodine** screw & nut driver
Norton type 15 lapper

Mail us your list of surplus machinery and let's "Keep 'em Flying"

MILES MACHINERY CO. - - - Saginaw, Mich.

MISCELLANEOUS MACHINES

#13 **NATCO** Mult. spdl. rect. hd. bored 16 spdls, with 8-1¼″ spindles
#60 **NATCO** 3-way Multiple Drill
25″ **Barnes** B.G. P.F. Sliding Head Drill
25″ **Rockford** B.G. P.F. Sliding Head Drill
#400 **Curtis** Oil Extractor, 2-bushel
4-spdl. **Henry & Wright**, 7″ overhang
Rockford Sgl. End Hydraulic Boring Unit, with 3-sta., 54″ dia. table
Gisholt Universal Tool Grinder

THE STRONG, CARLISLE & HAMMOND CO.
1392 West 3d St. Cleveland, Ohio — 2832 E. Grand Blvd., Detroit, Mich.

UNUSUAL VALUES

28″x20′6″ **Rahn-Carpenter Lathe** 14′ between centers
12″x6′ **Seneca Falls lathe**, loose change gear
#2 **Warner & Swasey** turret with cross slide turret
1 **Lodge & Davis** turret with cross slide turret
18″x8′ **Champion**, quick change
Brake: **Robinson** toggle 5′
Broaching Machines, LePointe, #1, #3
Drill Presses: 28″, 24″ Hoefer: 25″, 20″, 40″ Bement
Ceiling Suspended Drill Unlimited drilling area
2 50# **Bradley upright hammers**, m.d. like new
Radial Drills: 5″ Bausch
Millers: 20″x24″x18″ Ingersoll
Grinders: #20 Bryant Internal
300 other machinery items
Rock River ⅞″ capacity **punch and shear**
MOTORS—new 5 H.P. for 3-phase, ball brg.

Also rebuilt motors.

THE OSBORNE & SAXTON MACHINERY CO.
COLUMBUS, OHIO

No. 2 P & W Shaving Machine
No. 6 Fellows Gear Shaper
No. 3 Crescent Saw Table
Nos. 0 & 1 B & S Hand Turret Lathes
300-ton D & B Hydraulic Tire Press

D. E. DONY MACHINERY CO.
New and Used Machine Tools
47 Laurelton Road — Rochester, N. Y.

LATHES

9″x18″ **Porter Cable Lathe** (2)
No. 324 **Adriance Spinning**
26″x10′ **LeBlond, Universal Crankshaft**

MILLING MACHINES

2″ **Pratt & Whitney** spline (duplex) (Double)
No. 1 **Foote-Burt Surface Broach**
New No. 3 **Wigglesworth**
No. 2 **Knight Vertical**
No. 30 **Sunstrand Rigid Mill M.D.**

TURRET LATHES

2¼″ & 24″ **Jones & Lamson** steel H.D. M.D.
Goss & De Leeuw Chucking, 6″x6½″

DRILLS

3′ **Morris Radial** En. Hd. M.D.
No. B16 **Natco** M.D. (2)
4 Spindle **Taylor & Fenny** M.D.

GEAR MACHINERY

6 **Cimatool** chamfering M.D.
No. 6i **Fellows**
No. 4—48″ **Brown & Sharpe** Gear Cutter
Lees Bradner Gear Grinders (2)
9″ **Pratt & Whitney** Gear Grinder

GRINDERS

No. 20 **Heald** Surface M.D.
No. 16A **Blanchard** M.D.

MISCELLANEOUS

8″ **Bullard** Multimatic M.D.
No. 1 **Foote-Burt** Duplex Surface Broach
8″ **Welland** Standard Pipe Machine
No. 4 **Hilles & Jones** Double End Punch and Shear
No. 303 **Bliss** St. Side Gd. M.D.
2″ **Acme** Bolt Threader

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203 Bent St., Cambridge, Mass.

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GEAR CUTTERS, Spur, 30″, 36″ & 40″, M.D.
GEAR PLANERS, Bevel, 36″ & 54″ Gleason, M.D.
GRINDER, Univ., No. 5 B & S, 20″ x 72″.
GRINDER, 18′ x 30′ x 96′ Norton Cyl., M.D.
LATHE, Driving Wheel, 78″ Bement, Dbl. End.
PRESS, Hydr., 1000 ton Wood, platen 42″ x 9′
SLOTTER 15″ Dill Table Dia. 34″.

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14″ x 6′ **Hendey Engine Lathe**, Q.C. Cone Drive.
17″ x 8′ **Sidney H.D. Lathe**, Q.C. 3SCD, D.B.G.
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21″ x 10′ **LeBlond H.D.** 3 S.C.D. B.B.G. Q.C.
20″ x 8′ **American Lathe**, 3 S.C.D. D.B.G. Q.C.
14″ x 6′ **Lodge & Shipley Lathe**, 3 S.C.D. D.B.G. Q.C.
20″ x 8′ **LeBlond H.D. Lathe**, 3 S.C.D. D.B.G. Q.C.
42″ x 16′ **Niles Lathe**, Standard Change, Cone Drive.
28″ x 50″ x 16′ **Rahn Larmon Slid. Bed Gap Lathe**, Q. C.

GRINDERS

#60 **Heald** Internal, Belt Drive.
12″ **Pratt & Whitney** Surface Belt Drive.
#14—20″ **Besley Disc Grinder**, Belt Drive.
12″ x 72″ **Cincinnati Universal**, Belt Drive.
#41 **Oliver Drill Grinder**, M.D.

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#3—26″ B & S Automatic Gear Cutter.
#1 **Adams Gear Hobber**, Belt Drive.

BORING MILLS

36″ **Bullard Vertical**, Two Heads, M.D.

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4″ **Williams** Pipe Machine.
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2″ **Landis** Dble. Spindle Bolt Threader.
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800# **B & S Board Drop Hammer.**
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4′ **Bickford Radial Drill.**
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2¼" x 24" J. & L.
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4 spindle Allen Drill Presses

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#26 Brown & Sharpe
#3 Newark Spur
18" Gould & Eberhardt Spur & Bevel

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6' Prentice Gear Box, M.D.

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#5B Becker

SHAPERS
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BORING MILLS
36" Niles

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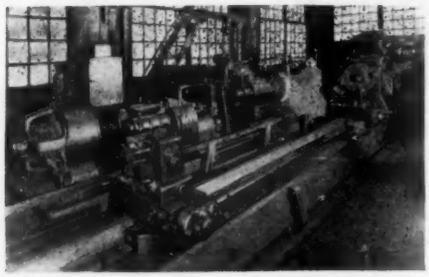

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BEDFORD 42" x 42" x 14'
OPEN SIDE PLANER
1 cross head, 1 side head.

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AUTOMATICS, Cleveland, ⅞" 4 spdle. Model M
AUTOMATICS, Cleveland, ⅞ & 1⅛" Model B, M. D.
AUTOMATICS, #22, 23 & 24 New Britain
GRINDERS, Landis 10x36" Hydraulic, M.D.
MILLING MACHINE, Lees-Bradner #3 Thread
MILLING MACHINES, Craftsman #1, 2 & 3
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PRESSES, Ferracute, P2, 3 & 4, Solid Back

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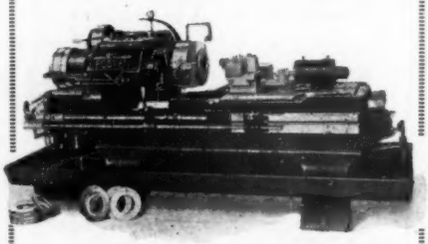

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22" Sibley
24" Hoeffer
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28" Welgle

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Norton double end
#4 Gardner Disc

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Fitchburg LoSwing
LeBlond Double End
Seneca Falls Lathe
16x6' Monarch Gap

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Porter #500 Vertical
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Taft Peirce Thread Mill
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Cincinnati Lathe & Tool Co., Cincinnati
Dumore Co., Racine, Wis.
Gisholt Machine Co., Madison, Wis.
Hardinge Brothers, Inc., Elmira, N. Y.
Hendey Machine Co., Torrington, Conn.
Jefferson Mach. Tool Co., Cincinnati
LeBlond Mach. Tool Co., R. K., Cincinnati
McCrosky Tool Corp., Meadville, Pa.
Monarch Machine Tool Co., Sidney, O.
Pratt & Whitney Div., Niles-Bement-Pond Co., Hartford, Conn.
Reed-Prentice Co., Worcester, Mass.
Rivett Lathe & Grinder, Inc., Boston
Rockford Mach. Tool Co., Rockford, Ill.
South Bend Lathe Wks., So. Bend, Ind.
Strand Co., N. A., Chicago
Warner & Swasey Co., Cleveland

ATTACHMENTS, Milling
Atlas Press Co., Kalamazoo, Mich.
Auto Ordnance Corp., Bridgeport, Conn.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Lathe & Tool Co., Cincinnati
Cincinnati Milling Mach. Co., Cincinnati
Consolidated Mach. Tool Corp., Rochester, N. Y.
Fray Machine Tool Co., Glendale, Calif.
Jefferson Mach. Tool Co., Cincinnati
Lempco Products, Inc., Bedford, O.
Kearney & Trecker Corp., Milwaukee
Kempsmith Machine Co., Milwaukee
National Machine Tool Co., Cincinnati
Porter-Cable Mach. Co., Syracuse, N. Y.
Pratt & Whitney Div., Niles-Bement-Pond Co., Hartford, Conn.
Producto Machine Co., Bridgeport, Conn.
Sundstrand Mach. Tool Co., Rockford, Ill.
Van Norman Machine Tool Co., Springfield, Mass.

ATTACHMENTS, Planer
Cincinnati Planer Co., Cincinnati
Sellers & Co., Inc., Wm., Philadelphia

ATTACHMENTS, Screw-Machine
Brown & Sharpe Mfg. Co., Providence, R. I.
Empire Tool Co., Detroit
Meisel Press Mfg. Co., Boston

ATTACHMENTS, Tapping
Avey Drilling Mach. Co., Cincinnati
Barber-Colman Co., Rockford, Ill.
Errington Mech. Lab., Stapleton, N. Y.
Greenlee Bros. & Co., Rockford, Ill.
Haskins Co., R. G., Chicago
Kingsbury Mach. Tool Corp., Keene, N. H.
Moline Tool Co., Moline, Ill.
Murchey Machine & Tool Co., Detroit
National Auto. Tool Co., Richmond, Ind.

BABBITT (See METALS, Bearing)

BALANCING MACHINES
Gisholt Machine Co., Madison, Wis.
Norton Co., Worcester, Mass.
Snyder Tool & Engrg. Co., Detroit
Sundstrand Mach. Tool Co., Rockford, Ill.
Taft-Peirce Mfg. Co., Woonsocket, R. I.

BALLS, Brass, Bronze & Steel
Federal Bearings Co., Poughkeepsie, N. Y.
SKF Industries, Inc., Philadelphia
Waterbury Steel Ball Co., Poughkeepsie, N. Y.

BARRELS, Tumbling & Burnishing
Waterbury Steel Ball Co., Poughkeepsie, N. Y.

BARS, Boring
Armstrong Bros. Tool Co., Chicago
Barber-Colman Co., Rockford, Ill.
Bullard Co., Bridgeport, Conn.
Carboloy Co., Detroit
Elmes Engrg. Wks., Chas. F., Chicago
Fray Machine Tool Co., Glendale, Cal.
Gairing Tool Co., Detroit
Gisholt Machine Co., Madison, Wis.
Haynes Stellite Co., N. Y. C.
Lucas Machine Tool Co., Cleveland
McCrosky Tool Corp., Meadville, Pa.
Michigan Tool Co., Detroit
National Twist Drill & Tool Co., Detroit
Pratt & Whitney Div., Niles-Bement-Pond Co., Hartford, Conn.
Rickert-Shafer Co., Erie, Pa.
Scully-Jones & Co., Chicago
Taft-Peirce Mfg. Co., Woonsocket, R. I.
Universal Boring Mach. Co., Hudson, Mass.
Warner & Swasey Co., Cleveland
Williams & Co., J. H., N. Y. C.

BARS, Sine
Brown & Sharpe Mfg. Co., Providence, R. I.
Starrett Co., L. S., Athol, Mass.
Taft-Peirce Mfg. Co., Woonsocket, R. I.

BATHS, Heat Treating & Annealing
Houghton & Co., E. F., Philadelphia

BEARINGS & BUSHINGS
Aluminum Co. of America, Pittsburgh
Bunting Brass & Bronze Co., Toledo, O.
Carlyle Johnson Machine Co., Manchester, Conn.
Johnson Bronze Co., New Castle, Pa.

BEARINGS, Babbitt
Bunting Brass & Bronze Co., Toledo, O.

BEARINGS, Ball
Bantam Bearings Corp., So. Bend, Ind.
Bearings Co. of America, Lancaster, Pa.
Fafnir Bearing Co., New Britain, Conn.
Federal Bearings Co., Poughkeepsie, N. Y.
Norma-Hoffmann Bearings Corp., Stamford, Conn.

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CONVERT YOUR ENGINE LATHE INTO A TURRET LATHE IN 15 SECONDS

To fit Bench lathes and lathes up to 24" swing.
Designed to increase production.
15 days delivery.

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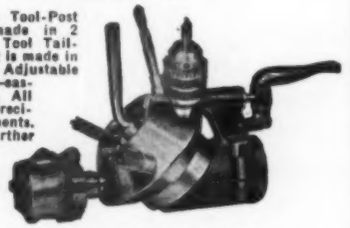
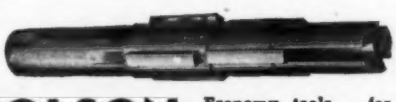
The 4 Tool Tool-Post Turret is made in 2 sizes. The 5 Tool Tail-Stock Turret is made in 4 sizes. Also Adjustable Full Feed—easily attached. All tools are precision attachments. Write for further details.



Also — Jefferson Precision Milling Machines, Milling Machine Dividing Heads, Vises, Belt Sanders, Swing Frame Grinders, Gyratory Foundry Riddles.

JEFFERSON MACHINE TOOL CO.
So. Sweeney, Cutter & Fourth Sts. Cincinnati, Ohio

Output Goes UP
Costs Go DOWN
with



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Economy tools . . . for holding work while being machined between centers on lathes, grinders, millers, shapers, etc. Hardened tool steel, accurately ground. Sold singly or in sets. Prompt delivery. Write for bulletin.

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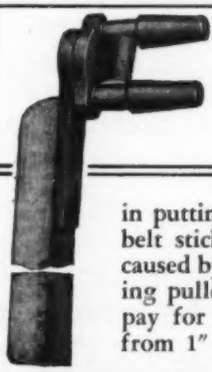

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in putting belts on moving pulleys. This belt stick attachment prevents accidents caused by throwing belts on and off moving pulleys. Avoid accidents rather than pay for them. Two sizes to cover belts from 1" to 4".

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IRANISTAN & R. R. AVES., BRIDGEPORT, CONN.

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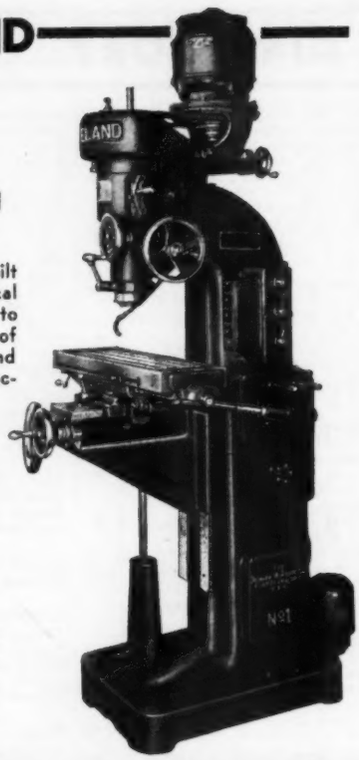
No. 1 NEW
Vertical Milling Machine

Here's a new . . . rigidly built . . . high speed . . . vertical milling Machine designed to meet the growing demands of the modern Tool Room, Die and Mold Shop and many Production Plants.



Features:

Choice of two ranges of Spindle Speeds: 12 speeds 100 to 1750 r.p.m. and 12 speeds 200 to 3450 r.p.m.
Table has 12 automatic longitudinal feeds ranging from 6" to 12½" per minute.
Capacity—Longitudinal Feed 18", Cross Travel 8½" Vertical Travel 16".
Table—Working Surface 8" x 32" with Three—1/32" T-slots 1⅞" center to center.
Power — 1½ H.P. motor, flange mounted with adjustable hand wheel for quick change of spindle speeds.
Cutter Capacity—1/16" to 2¼" Mills
Floor Space—36" wide x 42" deep x 87" high.

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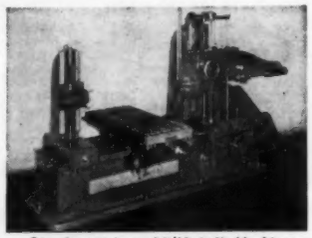
CLEVELAND . . . OHIO, U.S.A.

UNIVERSAL *Horizontal Boring Machine*
The only **TRIWAY** *Boring Machine Built*

Made in 3" and 4" spindle sizes. Write for complete, detailed specifications.



Standard Universal 3"Spindle Machine

UNIVERSAL BORING MACHINE CO.
Hudson, Mass., U. S. A.

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Horizontal Boring, Drilling and Milling Machine
THE LUCAS MACHINE TOOL CO.
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Bantam Bearings Corp., So. Bend, Ind.
Federal Bearings Co., Poughkeepsie, N. Y.
Norma-Hoffmann Bearings Corp., Stamford, Conn.
Roller Bearing Co. of Amer., Trenton, N. J.
S. K. F. Industries, Inc., Philadelphia
Torrington Co., Torrington, Conn.

BEARINGS, Non-Metallic
Bakelite Corp., N. Y. C.

BEARINGS, Oilless & Graphite
Bunting Brass & Bronze Co., Toledo, O.
Carlyle Johnson Machine Co., Manchester, Conn.
Johnson Bronze Co., New Castle, Pa.

BEARINGS, Roller
Bantam Bearings Corp., So. Bend, Ind.
Fafnir Bearing Co., New Britain, Conn.
Norma-Hoffmann Bearings Corp., Stamford, Conn.
Roller Bearing Co. of Amer., Trenton, N. J.
S. K. F. Industries, Inc., Philadelphia
Timken Roller Bearing Co., Canton, O.

BEARINGS, Thrust
(See preceding classifications)

BELLOWS, Seamless Metal
Chicago Metal Hose Corp., Maywood, Ill.

BELTING, Leather
Greene, Tweed & Co., N. Y. C.
Houghton & Co., E. F. Philadelphia

BELTING, Rubber & Fabric
Dayton Rubber Mfg. Co., Dayton, O.
Gates Rubber Co., Denver, Colo.

BELTS & BANDS, Abrasive
Behr-Manning Corp., Troy, N. Y.
Carborundum Co., Niagara Falls, N. Y.
Dumore Co., Racine, Wis.
Mid-West Abrasive Co., Detroit
Norton Company, Worcester, Mass.
Pratt & Whitney Div., Niles-Bement-Pond Co., Hartford, Conn.
Walls Sales Corp., N. Y. C.

BELTS "V"
Allis-Chalmers Mfg. Co., Milwaukee
Dayton Rubber Mfg. Co., Dayton, O.
Gates Rubber Co., Denver, Col.

BENCHES, Shop
Baumbach Mfg. Co., E. A., Chicago
Delta Mfg. Co., Milwaukee
Hardinge Brothers, Inc., Elmira, N. Y.
Hill Acme Co., Cleveland
Lyon Metal Products, Inc., Aurora, Ill.
New Britain-Gridley Machine Div., New Britain, Conn.
Rivett Lathe & Grinder, Inc., Boston
Standard Pressed Steel Co., Jenkintown, Pa.
Walker-Turner Co., Plainfield, N. J.

BENDERS, Hand
O'Neil-Irwin Mfg. Co., Minneapolis

BENDING & STRAIGHTENING Machines
Ajax Mfg. Co., Cleveland
Baldwin-Southwark Corp., Philadelphia
Buffalo Forge Co., Buffalo, N. Y.
Cincinnati Shaper Co., Cincinnati
Cleveland Punch & Shear Wks., Cleveland
Consolidated Machine Tool Corp., Rochester, N. Y.
Elmes Engrg. Works, Chas. F., Chicago
Farrel-Birmingham Co., Ansonia, Conn.
Hydraulic Press Mfg. Co., Mt. Gilead, O.
Niagara Mach. & Tool Wks., Buffalo, N. Y.
Ryerson & Son, Inc., Jos. T., Chicago
Schatz Mfg. Co., Poughkeepsie, N. Y.
Springfield Mach. Tool Co., Springfield, O.
Watson-Stillman Co., Roselle, N. J.

BINS, Tool & Parts (See **LOCKERS & SHELVING**)

BITS, Tool
Allegheny-Ludlum Steel Corp., Pittsburgh
Armstrong Bros. Tool Co., Chicago
Barber-Colman Co., Rockford, Ill.
Bethlehem Steel Co., Bethlehem, Pa.
Carboloy Co., Detroit
Carpenter Steel Co., Reading, Pa.
Cleveland Twist Drill Co., Cleveland
Crafts Co., Inc., Arthur A., Boston
Disston & Sons, Inc., Henry, Philadelphia
Firth-Sterling Steel Co., McKeesport, Pa.
Gairing Tool Co., Detroit
Gisholt Machine Co., Madison, Wis.
Haynes Stellite Co., N. Y. C.
Illinois Tool Works, Chicago
Latrobe Electric Steel Co., Latrobe, Pa.
McCrosky Tool Corp., Meadville, Pa.
McKenna Metals Co., Latrobe, Pa.
Michigan Tool Co., Detroit
Morse Twist Drill & Mach. Co., New Bedford, Mass.
National Broach & Machine Co., Detroit
National Tool Co., Cleveland
National Twist Drill & Tool Co., Detroit
Pratt & Whitney Div., Niles-Bement-Pond Co., Hartford, Conn.
Producto Machine Co., Bridgeport, Conn.
Ready Tool Co., Bridgeport, Conn.
Scully-Jones & Co., Chicago
Union Twist Drill Co., Athol, Mass.
Vanadium Alloys Steel Co., Pittsburgh
Vascoloy-Ramet Corp., N. Chicago, Ill.
Warner & Swasey Co., Cleveland
Wendt Sonis Co., Hannibal, Mo.
Williams & Co., J. H., N. Y. C.

BLADES, Circular-Saw (See **SAW BLADES, Circular**)

BLADES, Cutter, Milling, Boring & Reaming (See **BITS, Tool**)

BLADES, Hack- & Band-Saw
Armstrong-Blum Mfg. Co., Chicago
Atkins & Co., E. C., Indianapolis
Capewell Mfg. Co., Hartford, Conn.
Clemson Bros., Inc., Middletown, N. Y.
Continental Machines, Inc., Minneapolis
Disston & Sons, Inc., Henry, Philadelphia
Racine Tool & Mach. Co., Racine, Wis.
Starrett Co., L. S., Athol, Mass.
Thompson & Sons Co., Henry G., New Haven, Conn.
Victor Saw Works, Middletown, N. Y.

BLOCKS, Pillow
Allis-Chalmers Mfg. Co., Milwaukee
Earle Gear & Mach. Co., Philadelphia
Fafnir Bearing Co., New Britain, Conn.
Farrel-Birmingham Co., Ansonia, Conn.
Hill Acme Co., Cleveland
Norma-Hoffmann Bearings Corp., Stamford, Conn.
S. K. F. Industries, Inc., Philadelphia
Standard Pressed Steel Co., Jenkintown, Pa.

BLOCKS, Precision Gage
Atometric Precision Gage Laboratories, Inc., Stamford, Conn.
Brown & Sharpe Mfg. Co., Providence, R. I.
Dearborn Gage Co., Dearborn, Mich.
Lufkin Rule Co., Saginaw, Mich.
Pratt & Whitney Div., Niles-Bement-Pond Co., Hartford, Conn.
Scherr Co., Inc., Geo., N. Y. C.
Standard Gage Co., Poughkeepsie, N. Y.
Starrett Co., L. S., Athol, Mass.
Taft-Peirce Mfg. Co., Woonsocket, R. I.
Webber Gage Co., Cleveland

BLOCKS, "V"
Brown & Sharpe Mfg. Co., Providence, R. I.
Greenfield Tap & Die Corp., Greenfield, Mass.
Lufkin Rule Co., Saginaw, Mich.
Pratt & Whitney Div., Niles-Bement-Pond Co., Hartford, Conn.
Sheffield Corp., Dayton, O.
Starrett Co., L. S., Athol, Mass.
Taft-Peirce Mfg. Co., Woonsocket, R. I.

BLOWERS
Allis-Chalmers Mfg. Co., Milwaukee
American Gas Furn. Co., Elizabeth, N. J.
Buffalo Forge Co., Buffalo, N. Y.
General Electric Co., Schenectady, N. Y.
Strong, Carlisle & Hammond Co., Cleveland
Wagner Electric Corp., St. Louis

BLOWERS, Electric Hand
Buffalo Forge Co., Buffalo, N. Y.
Skilsaw, Inc., Chicago

BLUING, Layout
Dykem Co., St. Louis

BOLT & NUT MACHINES
Ajax Mfg. Co., Cleveland
Cleveland Automatic Mach. Co., Cleveland
Cone Automatic Mach. Co., Windsor, Vt.

WHERE-TO-BUY DIRECTORY

Consolidated Machine Tool Corp., Rochester, N. Y.
Eastern Machine Screw Corp., New Haven, Conn.
Federal Press Co., Elkhart, Ind.
Foote-Burt Co., Cleveland
Geometric Tool Co., New Haven, Conn.
Goss & deLeeuw Machine Co., New Britain, Conn.
Grant Mfg. & Mach. Co., Bridgeport, Conn.
Greenfield Tap & Die Corp., Greenfield, Mass.
Haskins Co., R. G., Chicago
Hendey Machine Co., Torrington, Conn.
Hill Acme Co., Cleveland
Landis Machine Co., Waynesboro, Pa.
Murchey Machine & Tool Co., Detroit
National Acme Co., Cleveland
New Britain-Gridley Machine Div., New Britain, Conn.
Oster Mfg. Co., Cleveland
Pratt & Whitney Div., Niles-Bement-Pond Co., Hartford, Conn.
Rickert-Shafer Co., Erie, Pa.
Scherr Co., Geo., N. Y. C.
Taft-Peirce Mfg. Co., Woonsocket, R. I.
V. & O. Press Co., Hudson, N. Y.

BOLTS, Eye
American Chain & Cable Co., Bridgeport, Conn.
Armstrong Bros. Tool Co., Chicago
Bethlehem Steel Co., Bethlehem, Pa.
Lamson & Sessions Co., Cleveland
Republic Steel Corp., Cleveland
Williams & Co., J. H., N. Y. C.

BOLTS & NUTS
Bethlehem Steel Co., Bethlehem, Pa.
Elastic Stop Nut Corp., Union, N. J.
Lamson & Sessions Co., Cleveland
Parker-Kalon Corp., N. Y. C.
Republic Steel Corp., Cleveland
Standard Pressed Steel Co., Jenkintown, Pa.
Williams & Co., J. H., N. Y. C.

BORING, DRILLING & MILLING MACHINES, Horizontal
Atlantic Machinery Co., N. Y. C.
Avey Drilling Mach. Co., Cincinnati
Barnes Co., W. F. & John, Rockford, Ill.
Baush Mach. Tool Co., Springfield, Mass.
Bryant Machinery & Engrg. Co., Chicago
Buhr Mach. Tool Co., Ann Arbor, Mich.
Cincinnati Gilbert Mach. Tool Co., Cincinnati
Consolidated Mach. Tool Corp., Rochester, N. Y.
Defiance Mach. Wks., Inc., Defiance, Ohio
Foote-Burt Co., Cleveland
General Machy. Corp., Hamilton, O.
Greenlee Bros. & Co., Rockford, Ill.
Lucas Machine Tool Co., Cleveland
Moline Tool Co., Moline, Ill.
National Acme Co., Cleveland
National Auto. Tool Co., Richmond, Ind.
Ohio Machine Tool Co., Kenton, O.
Sheffield Corp., Dayton, O.
Sellers & Co., Inc., Wm., Philadelphia
Snyder Tool & Engrg. Co., Detroit
Springfield Mach. Tool Co., Springfield, O.
Universal Boring Mach. Co., Hudson, Mass.
Yoder Co., Cleveland

BORING MACHINES, Jig (See **JIG-BORING MACHINES**)

BORING MACHINES, Precision
Barnes Co., W. F. & John, Rockford, Ill.
Bryant Machinery & Engrg. Co., Chicago
Ex-Cell-O Corp., Detroit
Heald Machine Co., Worcester, Mass.
Leland-Gifford Co., Worcester, Mass.
Lucas Machine Tool Co., Cleveland
Moline Tool Co., Moline, Ill.
National Auto. Tool Co., Richmond, Ind.
Pratt & Whitney Div., Niles-Bement-Pond Co., Hartford, Conn.
Rivett Lathe & Grinder, Inc., Boston
Sheffield Corp., Dayton, O.
Universal Boring Mach. Co., Hudson, Mass.

BORING MILLS, Vertical
Baush Mach. Tool Co., Springfield, Mass.
Bullard Co., Bridgeport, Conn.
Cincinnati Planer Co., Cincinnati
Consolidated Machine Tool Corp., Rochester, N. Y.
King Machine Tool Co., Cincinnati
Sellers & Co., Inc., Wm. Philadelphia
Springfield Mach. Tool Co., Springfield, O.

BOXES, Tote
Lucas & Son, Inc., J. L., Bridgeport, Conn.
Lyon Metal Products, Inc., Aurora, Ill.
Standard Pressed Steel Co., Jenkintown, Pa.

BRAKES, Bending, Power
Bryant Machinery & Engrg. Co., Chicago
Cincinnati Shaper Co., Cincinnati
Cleveland Crane & Engrg. Co., Wickliffe, O.
Cleveland Punch & Shear Wks. Co., Cleveland

BRAKES, Electric
General Electric Co., Schenectady, N. Y.
Westinghouse Electric & Mfg. Co., E. Pittsburgh

BRICK, Furnace (See **REFRACTORIES**)

BROACHES
American Broach & Machine Co., Ann Arbor, Mich.
Butterfield & Co., Derby Line, Vt.
Dalzen Tool & Mfg. Co., Detroit
Detroit Broach Co., Detroit
Detroit Tap & Tool Co., Detroit
East Shore Machine Products Co., Cleveland
Ex-Cell-O Corp., Detroit
Haynes Stellite Co., N. Y. C.
Illinois Tool Works, Chicago
Lapointe Mach. Tool Co., Hudson, Mass.
Michigan Tool Co., Detroit
National Broach & Mach. Co., Detroit
National Tool Co., Cleveland
Union Twist Drill Co., Athol, Mass.

BROACHING MACHINES
American Broach & Machine Co., Ann Arbor, Mich.
Cincinnati Milling Mach. Co., Cincinnati
Consolidated Machine Tool Corp., Rochester, N. Y.
Elmes Engrg. Works, Chas. F., Chicago
Foote-Burt Co., Cleveland
Hydraulic Press Mfg. Co., Mt. Gilead, O.
Lapointe Mach. Tool Co., Hudson, Mass.
Michigan Tool Co., Detroit
National Broach & Mach. Co., Detroit
Thompson Grinder Co., Springfield, O.

BRONZE, Phosphor (See **PHOSPHOR BRONZE**)

BUFFERS & POLISHERS
Black & Decker Mfg. Co., Towson, Md.
Blount Co., J. G., Everett, Mass.
Bridgeport Safety Emery Wheel Co., Bridgeport, Conn.
Continental Machines, Inc., Minneapolis
Delta Mfg. Co., Milwaukee
Dumore Co., Racine, Wis.
Gardner Machine Co., Beloit, Wis.
Hammond Machinery Builders, Inc., Kalamazoo, Mich.
Haskins Co., R. G., Chicago
Heald Machine Co., Worcester, Mass.
Hill-Acme Co., Cleveland
Jefferson Mach. Tool Co., Cincinnati
Landis Tool Co., Waynesboro, Pa.
Mattison Machine Works, Rockford, Ill.
New Britain-Gridley Mach. Co., New Britain, Conn.
Pratt & Whitney Div. Niles-Bement-Pond Co., Hartford, Conn.
Production Mach. Co., Greenfield, Mass.
Rotor Tool Co., Cleveland
Schauer Machine Co., Cincinnati
Stow Mfg. Co., Binghamton, N. Y.
Strand & Co., N. A., Chicago
Union Twist Drill Co., Athol, Mass.
Vonnegut Moulder Corp., Indianapolis
Walker-Turner Co., Plainfield, N. J.

BUFFERS & POLISHERS, Hand
Behr-Manning Corp., Troy, N. Y.
Roberts Rubber Co., Weldon, Newark, N. J.

BULLDOZERS
Ajax Mfg. Co., Cleveland
Baldwin-Southwark Corp., Philadelphia
Beatty Mach. & Mfg. Co., Hammond, Ind.
Elmes Eng. Works, Chas. F., Chicago
Hydraulic Press Mfg. Co., Mt. Gilead, O.
Watson-Stillman Co., Roselle, N. J.

BURNERS, Gas & Oil Furnace
American Gas Furn. Co., Elizabeth, N. J.
Hones, Inc., Charles A., Baldwin, N. Y.
Strong, Carlisle & Hammond Co., Cleveland
Surface Combustion Corp., Toledo, O.

BURNISHERS, Gear
Detroit Tap & Tool Co., Detroit

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PRODUCTION
These Criterion heads save time! Smooth, compact, rigid! Large, easy-to-read, graduated dial. Lead screw is hardened tool steel. ITS THREADS ARE GROUND FROM THE SOLID AFTER HARDENING, assuring constant accuracy. Parts subject to wear are hardened. Large offset adjustment eliminates need for offset boring bars. Two sizes: 1½" and 3" ½" and 1" bar capacity Ask your dealer, or order direct. Request free literature.
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STOPS LOSSES
making dies & templates
simply brush on, right at the bench; ready for the layout in a few minutes. The dark blue background makes the scribed layout lines show up in sharp relief, and at the same time prevents metal glare. Increases efficiency and accuracy.
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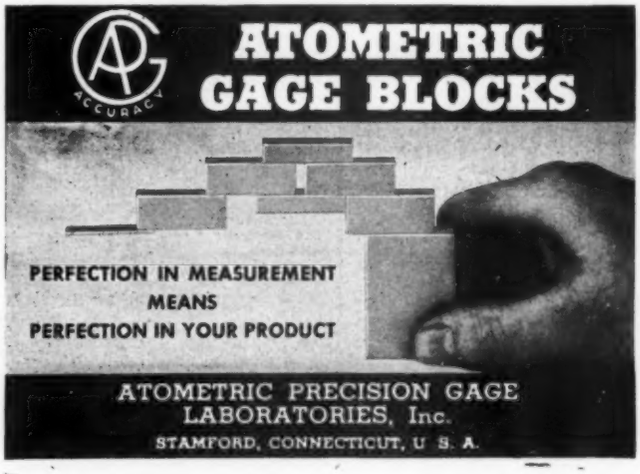

WHERE-TO-BUY DIRECTORY

Fellows Gear Shaper Co., Springfield, Vt.
Gleason Works, Rochester, N. Y.
Michigan Tool Co., Detroit
National Broach & Machine Co., Detroit
Pratt & Whitney Div. Niles-Bement-Pond Co., Hartford, Conn.

BURNISHING MACHINES
Consolidated Machine Tool Corp., Rochester, N. Y.
Fellows Gear Shaper Co., Springfield, Vt.
Michigan Tool Co., Detroit
Sheffield Corp., Dayton, O.

BURRING MACHINES
Ajax Mfg. Co., Euclid, Cleveland
Consolidated Mach. Tool Corp., Rochester, N. Y.
Cross Gear & Machine Co., Detroit
Hill Acme Co., Cleveland
National Broach & Machine Co., Detroit
Niagara Mach. & Tool Wks., Buffalo, N. Y.
Pratt & Whitney Div., Niles-Bement-Pond Co., Hartford, Conn.

BUSHINGS, Drill
Carboloy Co., Detroit
Detroit Tap & Tool Co., Detroit
Ex-Cell-O Corp., Detroit
Metal Carbides Corp., Youngstown, O.
Universal Engrg. Co., Frankenmuth, Mich.

CABINETS, Steel (See LOCKERS & SHELVING)

CALCULATORS, Electric
Marchant Calculating Machine Co., Oakland, Calif.

CALIPERS & COMPASSES
Armstrong Bros. Tool Co., Chicago
Brown & Sharpe Mfg. Co., Providence, R. I.
Farrel-Birmingham Co., Ansonia, Conn.
Lufkin Rule Co., Saginaw, Mich.
Randall & Stickney, Waltham, Mass.
Scherr Co., Geo., N. Y. C.
Slocomb Co., J. T., Providence, R. I.
Starrett Co., L. S., Athol, Mass.

CAMS, Machine
Brown & Sharpe Mfg. Co., Providence, R. I.
Cross Gear & Machine Co., Detroit
Hartford Special Machinery Co., Hartford, Conn.
Weldon Tool Co., Cleveland

CARBURIZERS (See also BOXES, Heat-Treating & Annealing)
American Gas Furn. Co., Elizabeth, N. J.
Houghton & Co., E. F., Philadelphia
Surface Combustion Corp., Toledo, O.

CARTRIDGE-CASE FINISHING MACHINES
Coulter Mach. Co., Jas., Bridgeport, Conn.
Sundstrand Mach. Tool Co., Rockford, Ill.

CASTINGS
American Brake Shoe & Fdry. Co., N. Y. C.
Brown & Sharpe Mfg. Co., Providence, R. I.
Bunting Brass & Bronze Co., Toledo
Elna Machine Co., Toledo, O.
Hill-Acme Co., Cleveland
Jefferson Mach. Tool Co., Cincinnati
Johnson Bronze Co., New Castle, Pa.
Mattison Machine Wks., Rockford, Ill.
Springfield Mach. Tool Co., Springfield, O.

CEMENT, Belt
Desmond-Stephan Mfg. Co., Urbana, O.
Houghton & Co., E. F., Philadelphia

CEMENT, Refractory
Carborundum Co., Niagara Falls, N. Y.
Norton Company, Worcester, Mass.

CENTERING MACHINES
Consolidated Mach. Tool Corp., Rochester, N. Y.
Hanson-Whitney Machine Co., Hartford, Conn.
Hendey Machine Co., Torrington, Conn.
Jones & Lamson Mach. Co., Springfield, Vt.
Pratt & Whitney Div., Niles-Bement-Pond Co., Hartford, Conn.
Seneca Falls Mach. Co., Seneca Falls, N. Y.
Snyder Tool & Engrg. Co., Detroit
Sundstrand Mach. Co., Rockford, Ill.

CENTERS, Bench
Brown & Sharpe Mfg. Co., Providence, R. I.
Dearborn Gage Co., Dearborn, Mich.
Pratt & Whitney Div., Niles-Bement-Pond Co., Hartford, Conn.
Starrett Co., L. S., Providence, R. I.

CENTERS, Machine
Abrasive Mach. Tool Co., E. Providence, R. I.
Brown & Sharpe Mfg. Co., Providence, R. I.
Bullard Company, Bridgeport, Conn.
Carboloy Co., Detroit
Cincinnati Lathe & Tool Co., Cincinnati
Cleveland Twist Drill Co., Cleveland
Firth-Sterling Steel Co., McKeesport, Pa.
Gisholt Machine Co., Madison, Wis.
Haynes Stellite Co., N. Y. C.
Hendey Machine Co., Torrington, Conn.
Knight Machinery Co., W. B., St. Louis
McKenna Metals Co., Latrobe, Pa.
Metal Carbides Corp., Youngstown, O.
Michigan Tool Co., Detroit
Morse Tool Co., Detroit
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Pratt & Whitney Div., Niles-Bement-Pond Co., Hartford, Conn.
Ready Tool Co., Bridgeport, Conn.
Scully-Jones & Co., Chicago
Standard Tool Co., Cleveland
Stevens, Inc., John B.
Sturdimatic Tool Co., Detroit
Taft-Peirce Mfg. Co., Woonsocket, R. I.
Vascoloy-Ramet Corp., N. Chicago, Ill.
Warner & Swasey Co., Cleveland
Wendt Sonis Co., Hannibal, Mo.

CENTRIFUGALS (See PURIFIERS, Oil & Coolant)

CENTRIFUGAL MACHINERY
Barrett Co., Leon J., Worcester, Mass.
DeLaval Separator Co., N. Y. C.

CHAIN, Forged-Steel Link
American Chain & Cable Co., Bridgeport, Conn.
Columbus-McKinnon Chain Corp., Tonawanda, N. Y.
McKay Co., Pittsburgh
Scully Steel Products Co., Chicago

CHAINS, Conveyor
Allis-Chalmers Mfg. Co., Milwaukee
American Chain & Cable Co., Bridgeport, Conn.

CHAINS, Transmission
Bilgram Gear & Mach. Wks., Philadelphia
Cincinnati Gear Co., Cincinnati
Morse Chain Co., Ithaca, N. Y.
Ohio Gear Co., Cleveland

CHAMFERING MACHINES
Bilgram Gear & Mach. Wks., Philadelphia
Consolidated Machine Tool Corp., Rochester, N. Y.
Cross Gear & Machine Co., Detroit
Grant Mfg. & Mach. Co., Bridgeport, Conn.
Lipe-Rollway Corp., Syracuse, N. Y.
Murchey Machine & Tool Co., Detroit
National Broach & Mach. Co., Detroit
Sheffield Corp., Dayton, O.

CHECKS, Metal, Time and Tool
Acromark Co., Elizabeth, N. J.
Noble & Westbrook Mfg. Co., East Hartford, Conn.
Revere Copper & Brass Inc., N. Y. C.

CHISELS, Hand (See TOOLS, Hand)

CHISELS, Chipping, Pneumatic & Electric Hammer
Bethlehem Steel Co., Bethlehem, Pa.
Black & Decker Mfg. Co., Towson, Md.
Cleveland Pneumatic Tool Co., Cleveland
Plomb Tool Co., Los Angeles, Calif.
Scully-Jones & Co., Chicago

CHUCKING MACHINES (See also LATHES, Automatic & Semi-Automatic)
Bullard Co., Bridgeport, Conn.
Cincinnati Lathe & Tool Co., Cincinnati
Cleveland Automatic Mach. Co., Cleveland
Cone Automatic Mach. Co., Windsor, Vt.
Foote-Burt Co., Cleveland
Gisholt Machine Co., Madison, Wis.
Gorton Mach. Co., George, Racine, Wis.
Goss & deLeeuw Mach. Co., New Britain, Conn.
Jones & Lamson Mach. Co., Springfield, Vt.
Lees-Bradner Co., Cleveland
National Acme Co., Cleveland
New Britain-Gridley Mach. Div., New Britain, Conn.
Potter & Johnston Machine Co., Pawtucket, R. I.
Warner & Swasey Co., Cleveland

CHUCKS, Air (See CHUCKS, Pneumatic)

CHUCKS, Collet (See Collets)

CHUCKS, Drill & Tap
Atlas Press Co., Kalamazoo, Mich.
Errington Mech. Lab., Stapleton, N. Y.
Ettco Tool Co., Brooklyn, N. Y.
Gisholt Machine Co., Madison, Wis.
Jacobs Mfg. Co., Hartford, Conn.
McCrosky Tool Corp., Meadville, Pa.
Morse Tool Co., Detroit
Morse Twist Drill & Mach. Co., New Bedford, Mass.
North Bros. Mfg. Co., Philadelphia
Rivett Lathe & Grinder, Inc., Boston
Scully-Jones & Co., Chicago
Standard Tool Co., Cleveland

CHUCKS, Drill, Quick-Change, Collet
Errington Mech. Lab., Stapleton, N. Y.
Gairing Tool Co., Detroit
Modern Tool Works, Rochester, N. Y.
Scully-Jones & Co., Chicago

CHUCKS, Gear
Cushman Chuck Co., Hartford, Conn.
Gleason Works, Rochester, N. Y.
Sheffield Corp., Dayton, O.

CHUCKS, Hydraulic
Cross Gear & Machine Co., Detroit
Cushman Chuck Co., Hartford, Conn.
Gisholt Machine Co., Madison, Wis.
New Britain-Gridley Machine Div., New Britain, Conn.
Potter & Johnston Machine Co., Pawtucket, R. I.
Tomkins-Johnson Co., Jackson, Mich
Warner & Swasey Co., Cleveland

CHUCKS, Lathe
Atlas Press Co., Kalamazoo, Mich.
Cincinnati Lathe & Tool Co., Cincinnati
Cushman Chuck Co., Hartford, Conn.
Delta Mfg. Co., Milwaukee
Gisholt Machine Co., Madison, Wis.
Hardinge Brothers, Inc., Elmira, N. Y
Harnischfeger Corp., Milwaukee
Hendey Machine Co., Torrington, Conn.
L-W Chuck Co., Toledo, O.
McCrosky Tool Corp., Meadville, Pa.
Potter & Johnston Machine Co., Pawtucket, R. I.
Pratt & Whitney Div., Niles-Bement-Pond Co., Hartford, Conn.
Rivett Lathe & Grinder, Inc., Boston
Scherr Co., Geo., N. Y. C.
Tomkins-Johnson Co., Jackson, Mich.

CHUCKS, Magnetic
Abrasive Mach. Tool Co., E. Providence, R. I.
Arter Grinding Mach. Co., Worcester, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Heald Machine Co., Worcester, Mass.
L-W Chuck Co., Toledo, O.
Taft-Peirce Mfg. Co., Woonsocket, R. I.
Walker Co., O. S., Worcester, Mass.

CHUCKS, Motorized Electric
Cushman Chuck Co., Hartford, Conn.
Goss & deLeeuw Machine Co., New Britain, Conn.
Potter & Johnston Machine Co., Pawtucket, R. I.
Warner & Swasey Co., Cleveland

CHUCKS, Pneumatic
Cushman Chuck Co., Hartford, Conn.
Potter & Johnston Machine Co., Pawtucket, R. I.
Tomkins-Johnson Co., Jackson, Mich.
Warner & Swasey Co., Cleveland

CHUCKS, Ring-Wheel
Abrasive Mach. Tool Co., E. Providence, R. I.
Bridgeport Safety Emery Wheel Co., Inc., Bridgeport, Conn.
Gardner Machine Co., Beloit, Wis.

CHUCKS, Spring
Brown & Sharpe Mfg. Co., Providence, R. I.
Harnischfeger Corp., Milwaukee
Rivett Lathe & Grinder, Inc., Boston

CLAMPS, Machinist's
Armstrong Bros. Tool Co., Chicago
Brown & Sharpe Mfg. Co., Providence, R. I.
Lufkin Rule Co., Saginaw, Mich.
North Bros. Mfg. Co., Philadelphia
Williams & Co., J. H., N. Y. C.

CLEANERS, Metal (See COMPOUNDS, Cleaning)

CLEANING EQUIPMENT (See METAL-CLEANING EQUIPMENT)

CLOTH, Abrasive (See PAPER & CLOTH, Abrasive)

CLOTHING, Industrial
Reeves Bros., Inc., N. Y. C.

CLUTCHES, Friction
Ajax Mfg. Co., Euclid, Cleveland
Allis-Chalmers Mfg. Co., Milwaukee
Carlyle Johnson Machine Co., Manchester, Conn.
Errington Mech. Lab., Stapleton, N. Y.
Foote Bros. Gear & Machine Co., Chicago
Hill Acme Co., Cleveland, O.
Lipe-Rollway Corp., Syracuse, N. Y.
Morse Chain Co., Ithaca, N. Y.
Reeves Pulley Co., Indianapolis

COLLARS, Safety
American Pulley Co., Philadelphia
Carlyle Johnson Machine Co., Manchester, Conn.
Standard Pressed Steel Co., Jenkintown, Pa.

COLLARS, Spacing
Atkins & Co., E. C., Indianapolis
Hill Acme Co., Cleveland
Morse Twist Drill & Machine Co., New Bedford, Mass.
Scully-Jones & Co., Chicago
Standard Pressed Steel Co., Jenkintown, Pa.

COLLECTORS, Dust
Blake Co., Edward, Newton Centre, Mass.
Buffalo Forge Co., Buffalo, N. Y.
Covel Mfg. Co., Benton Harbor, Mich.
Torit Mfg. Co., St. Paul, Minn.

COLLETS
Atlas Press Co., Kalamazoo, Mich.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Lathe & Tool Co., Cincinnati
Cincinnati Milling Mach. Co., Cincinnati
Cleveland Automatic Mach. Co., Cleveland
Cone Automatic Mach. Co., Windsor, Vt.
Consolidated Machine Tool Corp., Rochester, N. Y.
Cushman Chuck Co., Hartford, Conn.
Gisholt Machine Co., Madison, Wis.
Greenfield Tap & Die Corp., Greenfield, Mass.
Hardinge Brothers, Inc., Elmira, N. Y.
Hendey Machine Co., Torrington, Conn.
Morse Twist Drill & Machine Co., New Bedford, Mass.
National Acme Co., Cleveland
National Auto. Tool Co., Richmond, Ind.
National Twist Drill & Mach. Co., Detroit
New Britain-Gridley Machine Co., New Britain, Conn.
Pratt & Whitney Div., Niles-Bement-Pond Co., Hartford, Conn.
Reed Prentice Co., Worcester, Mass.
Rivett Lathe & Grinder, Inc., Boston
Scully-Jones & Co., Chicago
Standard Tool Co., Cleveland
Sundstrand Mach. Tool Co., Rockford, Ill.
Tomkins-Johnson Co., Jackson, Mich.
Union Twist Drill Co., Athol, Mass.
Universal Engrg. Co., Frankenmuth, Mich.
Van Norman Mach. Tool Co., Springfield, Mass.
Warner & Swasey Co., Cleveland

COMPARATORS, Dial
Brown & Sharpe Mfg. Co., Providence, R. I.
Federal Products Corp., Providence, R. I.
Pratt & Whitney Div., Niles-Bement-Pond Co., Hartford, Conn.
Scherr Co., Inc., Geo., N. Y. C.
Sheffield Corp., Dayton, O.
Starrett Co., L. S., Athol, Mass.
Taft-Peirce Mfg. Co., Woonsocket, R. I.
Vard, Inc., Pasadena, Calif.

COMPARATORS, Gear-Tooth & Screw-Thread
Farrel-Birmingham Co., Buffalo, N. Y.
Jones & Lamson Mach. Co., Springfield, Vt.
Pratt & Whitney Div., Niles-Bement-Pond Co., Hartford, Conn.
Scherr Co., Inc., Geo., N. Y. C.
Starrett Co., L. S., Athol, Mass.
Vard, Inc., Pasadena, Calif.

COMPASSES, Metal-Scribing (See CALIPERS & COMPASSES)

COMPOUNDS, Cleaning
Bullard Co., Bridgeport, Conn.
Detroit Rex Products Co., Detroit
Houghton & Co., E. F., Philadelphia
Oakite Products, N. Y. C.
Turco Products, Inc., Los Angeles

WHERE-TO-BUY DIRECTORY

COMPOUNDS, Drawing, Metal & Wire
Houghton & Co., E. F., Philadelphia
Shell Oil Co., Inc., N. Y. C.

COMPOUNDS, Grinding & Polishing
Carborundum Co., Niagara Falls, N. Y.
National Broach & Machine Co., Detroit
Norton Co., Worcester, Mass.

COMPOUNDS, Plastic Molding
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Dow Chemical Co., Midland, Mich.
General Electric Co., Schenectady, N. Y.
Westinghouse Elec. & Mfg. Co., E. Pittsburgh, Pa.

COMPOUNDS, Tempering & Case-Hardening
Houghton & Co., E. F., Philadelphia
Oakite Products, Inc., N. Y. C.
Strong, Carlisle & Hammond Co., Cleveland
Stuart Oil Co., D. A., Chicago

COMPRESSORS, Air & Gas
Allis-Chalmers Mfg. Co., Milwaukee
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Curtis Pneumatic Machry. Co., St. Louis
General Electric Co., Schenectady, N. Y.
Wright Mfg. Div. of Amer. Chain & Cable Co., York, Pa.

CONSULTANTS
Trundle Engrg. Co., Cleveland

CONTOUR MACHINES
Continental Machines, Inc., Minneapolis
Pratt & Whitney Div., Niles-Bement-Pond Co., Hartford, Conn.
Sundstrand Mach. Tool Co., Rockford, Ill.

CONTRACT WORK (See also Index, last page)
Aluminum Co. of America, Pittsburgh
Baldwin Southwark Corp., Philadelphia
Bayard & Co., M. L., Philadelphia
Chapman-Valve Mfg. Co., Boston (Heat-Treating)
Chromium Corp. of Amer., N.Y.C. (Plating)
Eastern Machine Screw Corp., New Haven, Conn.
Elmes Engrg. Wks., Chas. F., Chicago
Ericeson Screw Machine Prod. Inc., Brooklyn, N. Y.
Excello Corp., Detroit (Heat-Treating)
Fenn Mfg. Co., Hartford, Conn.
Greenlee Bros. & Co., Rockford, Ill.
Hamilton Tool Co., Hamilton, O.
Hartford Special Machy. Co., Hartford Conn.
Jefferson Mach. Tool Co., Cincinnati
Carlyle Johnson Machine Co., Manchester, Conn.
Kent-Owens Machine Co., Toledo, O.
Kropp Forge Co., Chicago (Forgings)
Liberty Tool & Gage Wks., Providence, R. I. (Jigs & Fixtures)
Meisel Press Mfg. Co., Boston
National Acme Co., Cleveland
National Twist Drill & Tool Co., Detroit
New Britain-Gridley Machine Co., New Britain, Conn. (Screw Machine Products)
Revere Copper & Brass, Inc., N. Y. C. (Forgings)
Scher Engrg. Co., George, Newark, N. J.
Stewart Iron Works Co., Inc., Cincinnati
Surface Combustion Corp., Toledo, O.
Taft-Peirce Mfg. Co., Woonsocket, R. I.
United Chromium, Inc., N. Y. C., (Plating)
Vard, Inc., Pasadena, Calif.
Watson-Stillman Co., Roselle, N. J.
Williams & Co., J. H., N. Y. C.

CONTROLLERS, Motor
Allen-Bradley Co., Milwaukee
Allis-Chalmers Mfg. Co., Milwaukee
Clark Controller Co., Cleveland
General Electric Co., Schenectady, N. Y.
Lincoln Electric Co., Cleveland
Square D Co., Milwaukee
Westinghouse Elec. & Mfg. Co., E. Pittsburgh

CONTROLLERS, Pressure & Temperature
American Gas Furn. Co., Elizabeth, N. J.
Brown Instrument Co., Philadelphia
Lindberg Engrg. Co., Chicago

CONTROLS, Flexible-Shaft (See **SHAFTS, Flexible**)

CONTROLS, Furnace
American Gas Furn. Co., Elizabeth, N. J.
Brown Instrument Co., Philadelphia
Lindberg Engrg. Co., Chicago
Strong, Carlisle & Hammond Mach. Co., Cleveland

CONTROLS, Hydraulic
Hydraulic Press Mfg. Co., Mt. Gilead, O
Sundstrand Mach. Tool Co., Rockford, Ill
Watson-Stillman Co., Roselle, N. J.

CONVEYORS
Allis-Chalmers Mfg. Co., Milwaukee
Mathews Conveyer Co., Ellwood City, Pa
Standard Conveyor Co., N. St. Paul, Minn.

COOLANTS, Cutting, Drilling & Grinding
Carborundum Co., Niagara Falls, N. Y
Gulf Oil Corp., Pittsburgh
Houghton & Co., E. F., Philadelphia
Oakite Products, Inc., N. Y. C.
Shell Oil Co., Inc., N. Y. C.
Socony-Vacuum Oil Co., Inc., N. Y. C
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Stuart Oil Co., Ltd., D. A., Chicago
Sun Oil Co., Philadelphia
Tidewater Associated Oil Co., N. Y. C

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Haynes Stellite Co., N. Y. C.
Michigan Tool Co., Detroit
Morse Tool Co., Detroit
Morse Twist Drill & Mach. Co., New Bedford, Mass.
National Tool Co., Cleveland
National Twist Drill & Tool Co., Detroit
Pratt & Whitney Div., Niles-Bement-Pond Co., Hartford, Conn.
Scully-Jones & Co., Chicago
Standard Tool Co., Cleveland
Union Twist Drill Co., Athol, Mass.
Vascoloy-Ramet Corp., N. Chicago, Ill.
Wendt Sonis Co., Hannibal, Mo.

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Hill Acme Co., Cleveland
LeBlond Mach. Tool Co., R. K., Cincinnati
Rivett Lathe & Grinder, Inc., Boston
Stow Mfg. Co., Binghamton, N. Y.
Warner & Swasey Co., Cleveland

COUNTERSINKS (See **DRILLS, Twist**

COUNTERS, Revolution & Stroke
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Scherr Co., Inc., Geo., N. Y. C.
Starrett Co., L. S., Athol, Mass.

COUPLINGS, Hose
Cleveland Pneu. Tool Co., Cleveland
Schrader's, Son, A., Brooklyn, N. Y.

COUPLINGS, Shaft, Flexible
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Delta Mfg. Co., Milwaukee
Earle Gear & Mach. Co., Philadelphia
Farrel-Birmingham Co., Buffalo, N. Y.
Foote Bros. Gear & Mach. Co., Chicago
Hill Acme Co., Cleveland
Morse Chain Co., Ithaca, N. Y.
Nicholson & Co., W. H., Wilkes-Barre, Pa.

COUPLINGS, Shaft, Non-Flexible
General Electric Co., Schenectady, N. Y.
Hill Acme Co., Cleveland
Standard Pressed Steel Co., Jenkintown, Pa.

CRANES, Jib
Chisholm-Moore Hoist Corp., Tonawanda, N. Y.
Cleveland Crane & Engrg. Co., Wickliffe, O.
Curtis Pneumatic Machy. Co., St. Louis
Harnischfeger Corp., Milwaukee
Wright Mfg. Div., American Chain & Cable Co., Inc., York, Pa.

CRANES, Portable
Chisholm-Moore Hoist Corp., Tonawanda, N. Y.
Wright Mfg. Div., American Chain & Cable Co., Inc., York, Pa.

CRANES, Overhead Traveling
Chisholm-Moore Hoist Corp., Tonawanda, N. Y.
Cleveland Crane & Engrg. Co., Wickliffe, O.
Curtis Pneumatic Machry. Co., St. Louis
Harnischfeger Corp., Milwaukee
Wright Mfg. Div., American Chain & Cable Co., Inc., York, Pa.

CUPS, Oil & Grease
Gits Bros. Mfg. Co., Chicago

CUSHIONS, Die
V. & O. Press Co., Hudson, N. Y.

CUTTERS, Angle
Barber-Colman Co., Rockford, Ill.
Brown & Sharpe Mfg. Co., Providence, R. I.
Butterfield & Co., Derby Line, Vt.
Carboloy Co., Detroit
Ex-Cell-O Corp., Detroit
Firth-Sterling Steel Co., McKeesport, Pa.
Gairing Tool Co., Detroit
Illinois Tool Works, Chicago
Michigan Tool Co., Detroit
McCrosky Tool Co., Meadville, Pa.
McKenna Metals Co., Latrobe, Pa.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
National Tool Co., Cleveland
National Twist Drill & Tool Co., Detroit
Pratt & Whitney Div., Niles-Bement-Pond Co., Hartford, Conn.
Scully-Jones & Co., Chicago

CUTTERS, Die-Sinking
Detroit Tap & Tool Co., Detroit
Gairing Tool Co., Detroit
Gorton Machine Co., Geo., Racine, Wis.
Illinois Tool Works, Chicago
Michigan Tool Co., Detroit
Morse Twist Drill & Machine Co., New Bedford, Mass.
National Tool Co., Cleveland
National Twist Drill & Tool Co., Detroit
Pratt & Whitney Div., Niles-Bement-Pond Co., Hartford, Conn.
Scully-Jones & Co., Chicago
Tomkins-Johnson Co., Jackson, Mich.
Union Twist Drill Co., Athol, Mass.

CUTTERS, Formed
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Brown & Sharpe Mfg. Co., Providence, R. I.
Carboloy Co., Detroit
Cleveland Twist Drill Co., Cleveland
Consolidated Machine Tool Corp., Rochester, N. Y.
Detroit Tap & Tool Co., Detroit
Disston & Sons, Inc., Henry, Philadelphia
Ex-Cell-O Corp., Detroit
Firth-Sterling Steel Co., McKeesport, Pa.
Gairing Tool Co., Detroit
Haynes Stellite Co., N. Y. C.
Illinois Tool Works, Chicago
Michigan Tool Co., Detroit
Morse Twist Drill & Machine Co., New Bedford, Mass.
National Tool Co., Cleveland
National Twist Drill & Tool Co., Detroit
Pratt & Whitney Div., Niles-Bement-Pond Co., Hartford, Conn.
Standard Tool Co., Cleveland
Taft-Peirce Mfg. Co., Woonsocket, R. I.
Tomkins Johnson Co., Jackson, Mich.
Union Twist Drill Co., Athol, Mass.
Weldon Tool Co., Cleveland

CUTTERS, Gear
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Cross Gear & Machine Co., Detroit
Farrel-Birmingham Co., Buffalo, N. Y.
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Gleason Works, Rochester, N. Y.
Illinois Tool Works, Chicago
Lees-Bradner Co., Cleveland
Michigan Tool Co., Detroit
Morse Tool Co., Detroit
Morse Twist Drill & Mach. Co., New Bedford, Mass.
National Broach & Mach. Co., Detroit
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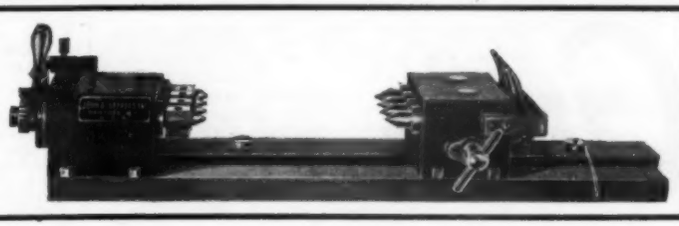

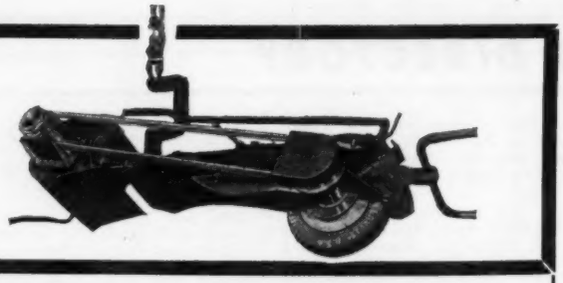

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Waltham Mach. Wks., Waltham, Mass.

CUTTERS, Hand Pipe (See **STOCKS, DIES & CUTTERS, Pipe**)

CUTTERS, Keyseater
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Barber-Colman Co., Rockford, Ill.
Brown & Sharpe Mfg. Co., Providence, R. I.
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Illinois Tool Works, Chicago
Michigan Tool Co., Detroit
Mitts & Merrill, Saginaw, Mich.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
National Broach & Mach. Co., Detroit
National Machine Tool Co., Cincinnati
National Tool Co., Cleveland
National Twist Drill & Tool Co., Detroit
Pratt & Whitney Div., Niles-Bement-Pond Co., Hartford, Conn.
Standard Tool Co., Cleveland
Union Twist Drill Co., Athol, Mass.

CUTTERS, Milling
Adams Company, Dubuque, Ia.
Atlas Press Co., Kalamazoo, Mich.
Barber-Colman Co., Rockford, Ill.
Brown & Sharpe Mfg. Co., Providence, R. I
Carboloy Co., Inc., Detroit
Cleveland Twist Drill Co., Cleveland
Crafts Co., Inc., Arthur A., Boston
Detroit Tap & Tool Co., Detroit
Disston & Sons, Inc., Henry, Philadelphia
Ex-Cell-O Corp., Detroit
Firth-Sterling Steel Co., McKeesport, Pa.
Gairing Tool Co., Detroit
Gorton Mach. Co., George, Racine, Wis.
Haynes Stellite Co., N. Y. C.
Illinois Tool Works, Chicago
Kearney & Trecker Corp., Milwaukee
Lovejoy Tool Co., Inc., Springfield, Vt.
McCrosky Tool Corp., Meadville, Pa.
McKenna Metals Co., Latrobe, Pa.
Michigan Tool Co., Detroit
Modern Tool Works, Rochester, N. Y.
Morse Tool Co., Detroit
Morse Twist Drill & Mach. Co., New Bedford, Mass.
National Tool Co., Cleveland
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Pratt & Whitney Div., Niles-Bement-Pond Co., Hartford, Conn.
Scully-Jones & Co., Chicago
Standard Tool Co., Cleveland
Tomkins-Johnson Co., Jackson, Mich.
Union Twist Drill Co., Athol, Mass.
Vascoloy-Ramet Corp., N. Chicago, Ill.
Waltham Mach. Wks., Waltham, Mass.
Weldon Tool Co., Cleveland
Wendt Sonis Co., Hannibal, Mo.
Williams & Co., J. H., N. Y. C.

CUTTING-OFF MACHINES (See **SAWS**)

CUTTING-OFF MACHINES, Abrasive-Wheel
Bridgeport Safety Emery Wheel Co., Bridgeport, Conn.
Campbell Div., Andrew C., American Chain & Cable Co., Bridgeport, Conn.
de Sanno & Sons, Inc., A. P., Philadelphia
Porter McLeod Machine Tool Co., Inc., Hatfield, Mass.
Racine Tool & Mach. Co., Racine, Wis.

CYLINDERS, Air (See **TANKS & CYLINDERS, Air**)

CYLINDERS, Hydraulic (See **PRESSES, Hydraulic**)

DEALERS, Machinery (See **Searchlight Section**)

DEGREASERS (See **Metal Cleaning Equipment**)

DEMAGNETIZERS
Abrasive Machine Tool Co., E. Providence, R. I.
Blanchard Mach. Co., Cambridge, Mass.
L-W Chuck Co., Toledo, O.
Taft-Peirce Mfg. Co., Woonsocket, R. I.
Walker Co., O. S., Worcester, Mass.

DIAMONDS, Industrial
Carboloy Co. Inc., Detroit
Crafts Co., Inc., Arthur A., Boston
Desmond-Stephan Mfg. Co., Urbana, O.
Diamond Tool Co., Chicago
Smit & Sons, Inc., J. K., N. Y. C.

DIE-CASTING MACHINES
Continental Machines, Inc., Minneapolis
Reed-Prentice Corp., Worcester, Mass.

DIE-HEADS, Threading
Armstrong Bros. Tool Co., Chicago
Butterfield & Co., Derby Line, Vt.
Card Mfg. Co., S. W., Mansfield, Mass.
Eastern Machine Screw Corp., New Haven, Conn.
Errington Mech. Lab., Stapleton, N. Y.
Geometric Tool Co., New Haven, Conn.
Greenfield Tap and Die Corp., Greenfield, Mass.
Hill Acme Co., Cleveland
Jones & Lamson Mach. Co., Springfield, Vt.
Landis Machine Co., Waynesboro, Pa.
Modern Tool Works, Rochester, N. Y.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Murchey Machine & Tool Co., Detroit
National Acme Co., Cleveland
Oster Mfg. Co., Cleveland
Pratt & Whitney Div. Niles-Bement-Pond Co., Hartford, Conn.
Rickert-Shafer Co., Erie, Pa.
Standard Tool Co., Cleveland
Union Twist Drill Co., Athol, Mass.
Warner & Swasey Co., Cleveland

DIE-MAKERS' SUPPLIES
Baumbach Mfg. Co., E. A., Chicago
Brown & Sharpe Mfg. Co., Providence, R. I.
Carboloy Co., Inc., Detroit
Danly Mach. Specialties, Inc., Chicago
Dykem Co., St. Louis
Lufkin Rule Co., Saginaw, Mich.
Masonite Corp., Chicago
Producto Mach. Co., Bridgeport, Conn.
Starrett Co., L. S., Athol, Mass.

DIE-MAKING & CUTTING MACHINES
Cincinnati Milling Mach. Co., Cincinnati
Continental Machines, Inc., Minneapolis
Gorton Machine Co., Geo., Racine, Wis.
Henry & Wright Mfg. Co., Hartford, Conn.
Illinois Tool Works, Chicago
Johnson Tool Co., E. Providence, R. I.
Peerless Machine Co., Racine, Wis.
Pratt & Whitney Div. Niles-Bement-Pond Co., Hartford, Conn.
Reed-Prentice Co., Worcester, Mass.

DIE-SETS
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Card Mfg. Co., S. W., Mansfield, Mass.
Dandy Mach. Specialties, Inc., Chicago
Morse Twist Drill & Machine Co., New Bedford, Mass.
Pratt & Whitney Div. Niles-Bement-Pond Co., Hartford, Conn.

DIE-SINKING MACHINES
Cincinnati Milling Mach. Co., Cincinnati
Gorton Machine Co., Geo., Racine, Wis.
Pratt & Whitney Div. Niles-Bement-Pond Co., Hartford, Conn.
Producto Mach. Co., Bridgeport, Conn.
Reed-Prentice Corp., Worcester, Mass.

DIES, Marking & Embossing
Acromark Co., Elizabeth, N. J.
Matthews & Co., Jas. H., Pittsburgh
Noble & Westbrook Mfg. Co., East Hartford, Conn.

DIES, Screw-Cutting, Adjustable
Butterfield & Co., Derby Line, Vt.
Card Mfg. Co., S. W., Mansfield, Mass.
Eastern Machine Screw Corp., New Haven, Conn.
Errington Mech. Lab., Stapleton, N. Y.
Geometric Tool Co., New Haven, Conn.
Greenfield Tap & Die Corp., Greenfield, Mass.
Jones & Lamson Mach. Co., Springfield, Vt.
Landis Machine Co., Waynesboro, Pa.
Modern Tool Works, Rochester, N. Y.
Morse Twist Drill & Machine Co., New Bedford, Mass.
Murchey Machine & Tool Co., Detroit
National Acme Co., Cleveland
Rickert-Shafer Co., Erie, Pa.
Standard Tool Co., Cleveland
Threadwell Tap & Die Co., Greenfield, Mass.

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Scully-Jones & Co., Chicago
Taft-Peirce Mfg. Co., Woonsocket, R. I.

DIES, Solid Bolt & Pipe
Armstrong Bros. Tool Co., Chicago
Butterfield & Co., Derby Line, Vt.
Card Mfg. Co., S. W., Mansfield, Mass.
Consolidated Machine Tool Corp., Rochester, N. Y.
Geometric Tool Co., New Haven, Conn.
Greenfield Tap & Die Corp., Greenfield, Mass.
Morse Twist Drill & Machine Co., New Bedford, Mass.
Oster Mfg. Co., Cleveland
Pratt & Whitney Div. Niles-Bement-Pond Co., Hartford, Conn.
Rickert-Shafer Co., Erie, Pa.
Warner & Swasey Co., Cleveland

DIES, Sub-Press
Baumbach Mfg. Co., E. A., Chicago
Danly Mach. Specialties, Inc., Chicago
Producto Machine Co., Bridgeport, Conn.
V & O Press Co., Hudson, N. Y.
Waltham Mach. Works, Waltham, Mass

DIES, Wire-Drawing & Extrusion
Carboloy Co., Inc., Detroit
Crafts Co., Arthur A., Boston
Firth-Sterling Steel Co., McKeesport, Pa.
Illinois Tool Works, Chicago
Metal Carbides Corp., Youngstown, O.
Taft-Peirce Mfg. Co., Woonsocket, R. I.
Vascoloy-Ramet Corp., N. Chicago, Ill.

DISKS, Abrasive (See **WHEELS, Grinding & Polishing**)

DISKS, Circular Cuttting
Atkins & Co., E. C., Indianapolis
Disston & Sons, Inc., Henry, Philadelphia
Morse Twist Drill and Machine Co., New Bedford, Mass.

DIVIDERS (See **CALIPERS & COMPASSES**)

DOGS, Lathe & Milling-Machine
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Cincinnati Lathe & Tool Co., Cincinnati
Hendey Machine Co., Torrington, Conn.
LeBlond Mach. Tool Co., R. K., Cincinnati
Ready Tool Co., Bridgeport, Conn.
Sturdimatic Tool Co., Detroit
Williams & Co., J. H., N. Y. C.

DRESSERS, Grinding Wheel
American Swiss File & Tool Co., Elizabeth, N. J.
Atkins & Co., E. C., Indianapolis
Black & Decker Mfg. Co., Towson, Md.
Carboloy Co., Inc., Detroit
Carborundum Co., Niagara Falls, N. Y.
Chicago Wheel & Mfg. Co., Chicago
Crafts Co., Inc., Arthur A., Boston
Desmond-Stephan Mfg. Co., Urbana, O.
Disston & Sons, Inc., Henry, Philadelphia
Dumore Co., Racine, Wis.
Metal Carbides Corp., Youngstown, O.
Norton Co., Worcester, Mass.
Schultz & Anderson Co., Newark (Radius)
Smit & Sons, J. K., N. Y. C.
Standard Tool Co., Cleveland
Victor Machinery Exchange, N. Y. C.

DRESSING, Belt
Houghton & Co., E. F., Philadelphia
Tide Water Associated Oil Co., N. Y. C.
White & Bagley, Worcester, Mass.

DRIERS, Centrifugal
Barrett Co., Leon J., Worcester, Mass.
DeLaval Separator Co., N. Y. C.

DRIFTS, Drill
Armstrong Bros. Tool Co., Chicago
Cleveland Twist Drill Co., Cleveland
Morse Twist Drill & Machine Co., New Bedford, Mass.
Standard Tool Co., Cleveland

DRILLROD, Steel Tool (See **STEEL, Tool**)

DRILLS, Automatic & Semi-Automatic
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Baker Bros., Inc., Toledo, O.
Barnes Co., W. F. & John, Rockford, Ill
Barnes Drill Co., Rockford, Ill.
Bodine Corp., Bridgeport, Conn.
Bradford Machine Tool Co., Cincinnati
Buffalo Forge Co., Buffalo, N. Y.
Cincinnati Bickford Tool Co., Cincinnati
Cincinnati Gilbert Machine Tool Co., Cincinnati
Consolidated Mach. Tool Corp., Rochester, N. Y.
Cross Gear and Machine Co., Detroit
Davis & Thompson Co., Milwaukee
Ex-Cell-O Corp., Detroit
Foote-Burt Co., Cleveland
Fosdick Machine Tool Co., Cincinnati
Goss & deLeeuw Machine Co., New Britain, Conn.
Greenlee Bros. & Co., Rockford, Ill.
Kingsbury Mach. Tool Co., Keene, N. H.
Leland-Gifford Co., Worcester, Mass.
Moline Tool Co., Moline, Ill.
National Auto. Tool Co., Richmond, Ind.
North Bros. Mfg. Co., Philadelphia
Pratt & Whitney Div., Niles-Bement-Pond Co., Hartford, Conn.
Snyder Tool & Engrg. Co., Detroit
Sundstrand Mach. Tool Co., Rockford, Ill.

DRILLS, Bench
Atlas Press Co., Kalamazoo, Mich.
Avey Drilling Machine Co., Cincinnati
Barnes Co., W. F. & John, Rockford, Ill.
Black & Decker Mfg. Co., Towson, Md.
Buffalo Forge Co., Buffalo, N. Y.
Cincinnati Bickford Tool Co., Cincinnati
Delta Mfg. Co., Milwaukee
Dumore Co., Racine, Wis.
Foote-Burt Co., Cleveland
Fosdick Machine Tool Co., Cincinnati
Hamilton Tool Co., Hamilton, O.
Henry & Wright Mfg. Co., Hartford, Conn.
Leland-Gifford Co., Worcester, Mass.
Moline Tool Co., Moline, Ill.
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Pratt & Whitney Div. Niles-Bement-Pond Co., Hartford, Conn.
Production Mach. Co., Greenfield, Mass.
Ryerson & Son, Jos. T., Chicago
Schauer Mach. Co., Cincinnati
Skilsaw, Inc., Chicago
Walker-Turner Co., Plainfield, N. J.

DRILLS, Breast (See **TOOLS, Hand**)

DRILLS, Center
Cleveland Twist Drill Co., Cleveland
Firth-Sterling Steel Co., McKeesport, Pa.
Greenfield Tap & Die Corp., Greenfield, Mass.
Morse Twist Drill and Machine Co., New Bedford, Mass.
National Twist Drill & Tool Co., Detroit
Pratt & Whitney Co., Div. Niles-Bement-Pond Co., Hartford, Conn.
Slocomb Co., J. T., Providence, R. I.
Standard Tool Co., Cleveland
Union Twist Drill Co., Athol, Mass.
Victor Machinery Exchange, N. Y. C.

DRILLS, Column-Type
Atlas Press Co., Kalamazoo, Mich.
Baker Bros., Inc., Toledo, O.
Barnes Drill Co., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Buffalo Forge Co., Buffalo, N. Y.
Cincinnati Bickford Tool Co., Cincinnati
Cincinnati Gilbert Machine Tool Co., Cincinnati
Consolidated Machine Tool Corp., Rochester, N. Y.
Dalzen Tool & Mfg. Co., Detroit
Davis & Thompson Co., Milwaukee
Foote-Burt Co., Cleveland
Fosdick Machine Tool Co., Cincinnati
General Machy. Corp., Hamilton, O.
Leland-Gifford Co., Worcester, Mass.
Moline Tool Co., Moline, Ill.
National Auto. Tool Co., Richmond, Ind.
Snyder Tool & Engrg. Co., Detroit

DRILLS, Core
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Ex-Cell-O Corp., Detroit
Firth-Sterling Steel Co., McKeesport, Pa.
Gairing Tool Co., Detroit
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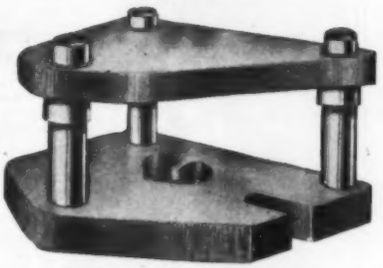

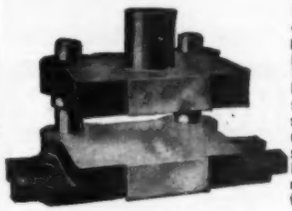

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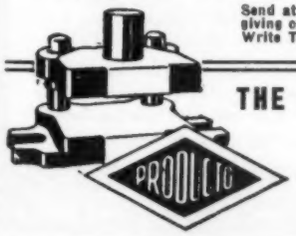

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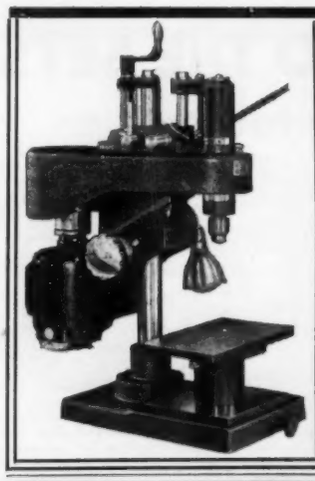

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Scherr Co., Geo., N. Y. C.
Snyder Tool & Engrg. Co., Detroit

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DRILLS, Portable Pneumatic (See TOOLS. Portable Pneumatic)

DRILLS, Radial
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Page Steel & Wire Div., Am. Chain & Cable Co., Monessen, Pa.
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Morse Twist Drill & Mach. Co., New Bedford, Mass.
Standard Tool Co., Cleveland

FANS, Man-Cooler (See BLOWERS)

FEEDS, Die (See FEEDS, Press)

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Stow Mfg. Co., Inc., Binghamton, N. Y.
Strand & Co., N. A., Chicago

FILES, Rotary
Disston & Sons, Inc., Henry, Philadelphia
Hamilton Tool Co., Hamilton, O.
Strand & Co., N. A., Chicago

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Ames Co., B. C., Waltham, Mass.
Continental Machines Inc., Milwaukee
Do All Co., Inc., Des Plaines, Ill.
Illinois Tool Co., Chicago
Oliver Instrument Co., Adrian, Mich.

FILTERS, Air
Cleveland Pneu. Tool Co., Cleveland
Curtis Pneu. Machy. Co., St. Louis
Norton Company, Worcester, Mass.

FINGERS, Feed
Eastern Machine Screw Corp., New Haven, Conn.
Hardinge Brothers, Inc., Elmira, N. Y.
Mitts & Merrill, Saginaw, Mich.
Rivett Lathe & Grinder, Inc., Boston

FITTINGS, Hydraulic
Lamson & Sessions Co., Cleveland
Watson-Stillman Co., Roselle, N. J.

FITTINGS, Wire-Rope
American Chain & Cable Co., Bridgeport, Conn.
American Steel & Wire Co., Chicago
Bethlehem Steel Co., Bethlehem, Pa.
Republic Steel Corp., Cleveland
Roebling's Sons Co., John A., Trenton, N.J.

FIXTURES, Indexing
Brown & Sharpe Mfg. Co., Providence, R. I.
Hartford Special Machinery Co., Hartford, Conn.
Jefferson Mach. Tool Co., Cincinnati
Zagar Tool Inc., Cleveland

FLAME-CUTTING MACHINES
Air Reduction, N. Y. C.
Oster Mfg. Co., Cleveland

FLEXIBLE SHAFT EQUIPMENT
Haskins Mfg. Co., R. G., Chicago
Strand Mfg. Co., N. A., Chicago

FLUX, Liquid & Paste
Air Reduction, N. Y. C.
Atkins & Co., E. C., Indianapolis
Lincoln Electric Co., Cleveland

FORGES
Buffalo Forge Co., Buffalo, N. Y.

FORGING MACHINES (See also PRESSES, Forging)
Ajax Mfg. Co., Euclid, Cleveland
Elmes Engrg. Wks., Chas. F., Chicago
Hill-Acme Co., Cleveland

FORMING Machines
Ajax Mfg. Co., Euclid, Cleveland
Cincinnati Shaper Co., Cincinnati
Cleveland Punch & Shear Wks., Cleveland
Consolidated Mach. Tool Corp., Rochester, N. Y.
Elmes Engrg. Works, Chas. F., Chicago
Farrel-Birmingham Co., Ansonia, Conn.
Henry & Wright Mfg. Co., Hartford, Conn
Hydraulic Press Mfg. Co., Mt. Gilead, O.
Niagara Mach. & Tool Wks., Buffalo, N. Y.
Nilson Machine Co., A. H., Bridgeport, Conn.
Schatz Mfg. Co., Poughkeepsie, N. Y
Watson-Stillman Co., Roselle, N. J.
Yoder Co., Cleveland
Zeh & Hahnemann Co., Newark, N. J.

FURNACES, Electric
Electric Furnace Co., Salem, O.
General Electric Co., Schenectady, N. Y.
Lindberg Engineering Co., Chicago
Surface Combustion Corp., Toledo, O.
Westinghouse Electric & Mfg. Co., E. Pittsburgh

FURNACES, Gas
American Gas Furn. Co., Elizabeth, N. J.
Chicago Flexible Shaft Co., Chicago
Electric Furnace Co., Salem, Ohio
Hones, Inc., Chas. A. Baldwin, N. Y.
Lindberg Engineering Co., Chicago
Strong, Carlisle & Hammond Co., Cleveland
Surface Combustion Corp., Toledo, O.

FURNACES, Oil
Chicago Flexible Shaft Co., Chicago
Electric Furnace Co., Salem, O.
Surface Combustion Corp., Toledo

FURNITURE, Shop
Black & Decker Mfg. Co., Towson, Md. (Drill Stands)
Hamilton Tool Co., Hamilton, O.

1905 Strand 1942
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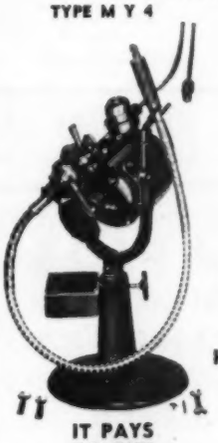
CAPACITIES—⅛ TO 3 H.P.
VERTICAL AND HORIZONTAL
TYPE M Y 4



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New 1/10,000" Indicator
Model C-10

Range	3"
Diameter of case	1 15/16"
Diameter over all	2½"
Depth of case	⅞"
Length over all	3½"
Lug or Bracket—Offset, on center if desired	Hole 3/16"
Back held in position by	4 large screws
Center of spindle to center of hole in lug	15/16"
Weight	8 ounces
Stem	9/32 diam.
Dial	0-5-0 or 0-10
Graduated	.0001
Crystal	Non-breakable

Model C-10

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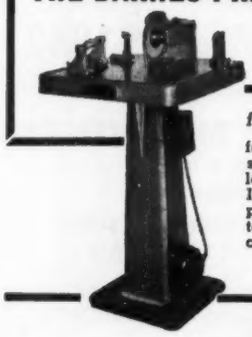

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fast grinding of formed cutters with assurance of preserving form exactly and lengthening cutter life five to eight times. It will grind gangs of formed cutters—plain, concave, convex or angular—shell tools— shank tools—form turning tools—cutters with undercut and spiral teeth.

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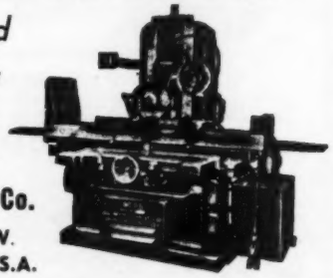

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Lyon Metal Prod., Inc., Aurora, Ill.
New Britain-Gridley Machine Co., New Britain, Conn.
Standard Pressed Steel Co., Jenkintown, Pa.

GAGES, Amplifying
Federal Products Corp., Providence, R. I.
Pratt & Whitney Co., Hartford, Conn
Scherr Co., Geo., N. Y. C.
Sheffield Corp., Dayton, O.
Standard Gage Co., Poughkeepsie, N. Y

GAGES, Caliper
Brown & Sharpe Mfg. Co., Providence, R. I
Federal Products Corp., Providence, R. I.
Lufkin Rule Co., Saginaw, Mich.
Sheffield Corp., Dayton, O.
Slocomb Co., J. T., Providence, R. I.
Starrett Co., L. S., Athol, Mass.
Taft-Peirce Mfg. Co., Woonsocket, R. I.

GAGES, Comparator
Ames Co., B. C., Waltham, Mass.
Federal Products Corp., Providence, R. I
Jones & Lamson Mach. Co., Springfield Vt.
Pratt & Whitney Div. Niles-Bement-Pond Co., Hartford, Conn.
Scherr Co., Geo., N. Y. C.
Sheffield Corp., Dayton, O.
Standard Gage Co., Poughkeepsie, N. Y
Starrett Co., L. S., Athol, Mass.
Taft-Peirce Mfg. Co., Woonsocket, R. I

GAGES, Depth
Ames Co., B. C., Waltham, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I
Continental Machines, Inc., Minneapolis
Federal Products Corp., Providence, R. I
Lufkin Rule Co., Saginaw, Mich.
Pratt & Whitney Div. Niles-Bement-Pond Co., Hartford, Conn.
Scherr Co., Inc., Geo., N. Y. C.
Sheffield Corp., Dayton, O.
Standard Gage Co., Poughkeepsie, N. Y.
Starrett Co., L. S., Athol, Mass.
Taft-Peirce Mfg. Co., Woonsocket, R. I.

GAGES, Dial
Ames Co., B. C., Waltham, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Federal Products Corp., Providence, R. I.
Randall & Stickney, Waltham, Mass.
Standard Gage Co., Poughkeepsie, N. Y
Starrett Co., L. S., Athol, Mass.
Taft-Peirce Mfg. Co., Woonsocket, R. I.

GAGES, Drill-Center
Brown & Sharpe Mfg. Co., Providence, R. I.
Lufkin Rule Co., Saginaw, Mich.
Morse Twist Drill Co., New Bedford, Mass.
Slocomb Co., J. T., Providence, R. I.
Standard Tool Co., Cleveland
Starrett Co., L. S., Athol, Mass.
Union Twist Drill Co., Athol, Mass.

GAGES, Height
Brown & Sharpe Mfg. Co., Providence, R. I.
Continental Machines, Inc., Minneapolis
Lufkin Rule Co., Saginaw, Mich.
Scherr Co., Inc., Geo., N. Y. C.
Starrett Co., L. S., Athol, Mass.

GAGES, Plug & Ring
Brown & Sharpe Mfg. Co., Providence, R. I.
Cadillac Gage Co., Detroit
Carboloy Co., Detroit
Crafts Co., Inc., Arthur A., Boston
Detroit Tap & Tool Co., Detroit
Federal Products Corp., Providence, R. I
Greenfield Tap & Die Corp., Greenfield, Mass.
Hanson-Whitney Machine Co., Hartford, Conn.
Lincoln Park Tool & Gage Co., Lincoln Park, Mich.
Michigan Tool Co., Detroit
Morse Twist Drill & Machine Co., New Bedford, Mass.
Pratt & Whitney Div. Niles-Bement-Pond Co., Hartford, Conn.
Scherr Co., Inc., Geo., N. Y. C.
Sheffield Corp., Dayton, O.
Slocomb Co., J. T., Providence, R. I.
Standard Gage Co., Poughkeepsie, N. Y
Taft-Peirce Mfg. Co., Woonsocket, R. I
Vard, Inc., Pasadena, Calif.

GAGES, Pressure
Baldwin-Southwark Corp., Philadelphia
Brown Instrument Co., Philadelphia

GAGES, Profile
Pratt & Whitney Div., Niles-Bement-Pond Co., Hartford, Conn.
Sheffield Corp., Dayton, O.
Standard Gage Co., Poughkeepsie, N. Y.
Taft-Peirce Mfg. Co., Woonsocket, R. I.

GAGES, Snap (See GAGES, Plug & Ring)

GAGES, Surface
Ames Co., B. C., Waltham, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Lufkin Rule Co., Saginaw, Mich.
Starrett Co., L. S., Athol, Mass.

GAGES, Thickness
Ames Co., B. C., Waltham, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Federal Products Corp., Providence, R. I.
Lufkin Rule Co., Saginaw, Mich.
Pratt & Whitney Div., Niles-Bement-Pond Co., Hartford, Conn.
Randall & Stickney Co., Waltham, Mass.
Scherr Co., Inc., Geo., N. Y. C.
Sheffield Corp., Dayton, O.
Standard Gage Co., Poughkeepsie, N. Y.
Starrett Co., L. S., Athol, Mass.
Taft-Peirce Mfg. Co., Woonsocket, R. I.

GAGES, Thread
Brown & Sharpe Mfg. Co., Providence, R. I.
Cadillac Gage Co., Detroit
Detroit Tap & Tool Co., Detroit
Federal Products Corp., Providence, R. I.
Greenfield Tap & Die Corp., Greenfield, Mass.
Hanson-Whitney Mach. Co., Hartford, Conn.
Lufkin Rule Co., Saginaw, Mich.
Michigan Tool Co., Detroit
Pratt & Whitney Div., Niles-Bement-Pond Co., Hartford, Conn.
Scherr Co., Inc., Geo., N. Y. C.
Sheffield Corp., Dayton, O.
Slocomb Co., J. T., Providence, R. I.
Starrett Co., L. S., Athol, Mass.
Taft-Peirce Mfg. Co., Woonsocket, R. I.
Vard, Inc., Pasadena, Calif.

GAGES, Wire
Atkins & Co., E. C., Indianapolis
Brown & Sharpe Mfg. Co., Providence, R. I.
Disston & Sons, Inc., Henry, Philadelphia
Federal Products Corp., Providence, R. I.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Standard Tool Co., Cleveland
Starrett Co., L. S., Athol, Mass.

GALVANIZING MACHINES (See ENAMELING & GALVANIZING MACHINES)

GASES, Compressed
Air Reduction, N. Y. C.

GEAR-CUTTING MACHINES
Adams Co., Dubuque, Iowa
Barber-Colman Co., Rockford, Ill.
Bilgram Gear & Mach. Wks., Philadelphia
Brown & Sharpe Mfg. Co., Providence, R. I.
Cross Gear & Machine Co., Detroit
Farrel-Birmingham Co., Buffalo, N. Y.
Fellows Gear Shaper Co., Springfield, Vt.
General Mach. Corp., Hamilton, O.
Gleason Works, Rochester, N. Y.
Illinois Tool Works, Chicago
Lees-Bradner Co., Cleveland
Michigan Tool Co., Detroit
National Broach & Machine Co., Detroit
National Tool Co., Cleveland
Newark Gear Cutting Mach. Co., Newark, N. J.
Pratt & Whitney Div., Niles-Bement-Pond Co., Hartford, Conn.
Producto Mach. Co., Bridgeport, Conn.
Scherr Co., Inc., Geo., N. Y. C.
Waltham Mach. Wks., Waltham, Mass.

GEAR-TESTING MACHINES
Brown & Sharpe Mfg. Co., Providence, R. I.
Farrel-Birmingham Co., Buffalo, N. Y.
Fellows Gear Shaper Co., Springfield, Vt.
Gleason Works, Rochester, N. Y.
Illinois Tool Works, Chicago
Lees-Bradner Co., Cleveland
Michigan Tool Co., Detroit
Morse Twist Drill & Machine Co., New Bedford, Mass.
National Broach & Mach. Co., Detroit
Pratt & Whitney Div., Niles-Bement-Pond Co., Hartford, Conn.
Scherr Co., Inc., Geo., N. Y. C.

WHERE-TO-BUY DIRECTORY

GEARS, Cast
Braun Gear Corp., Brooklyn, N. Y.
Earle Gear & Machine Co., Philadelphia
Farrel-Birmingham Co., Ansonia, Conn.
Foote Bros. Gear & Mach. Co., Chicago
Ganschow Gear Co., Chicago
General Electric Co., Schenectady, N. Y.
Grant Gear Works Inc., Boston
Ohio Gear Co., Cleveland
Perkins Machine & Gear Co., Springfield, Mass.
Philadelphia Gear Works, Philadelphia

GEARS, Cut
Adams Co., Dubuque, Iowa
Allis-Chalmers Mfg. Co., Milwaukee
Baush Mach. Tool Co., Springfield, Mass.
Bilgram Gear & Mach. Wks., Philadelphia
Brown & Sharpe Mfg. Co., Providence, R. I.
Braun Gear Corp., Brooklyn, N. Y.
Carlyle Johnson Machine Co., Manchester, Conn.
Cincinnati Gear Co., Cincinnati
Cincinnati Lathe & Tool Co., Cincinnati
Earle Gear & Machine Co., Philadelphia
Farrel-Birmingham Co., Buffalo, N. Y.
Fellows Gear Shaper Co., Springfield, Vt.
Foote Bros. Gear & Mach. Co., Chicago
Ganschow Gear Co., Chicago
Gear Specialties Inc., Chicago
Gleason Works, Rochester, N. Y.
Grant Gear Works, Inc., Boston
Hartford Special Machinery Co., Hartford, Conn.
Meisel Press Mfg. Co., Boston
Michigan Tool Co., Detroit
Morse Chain Co., Ithaca, N. Y.
Ohio Gear Co., Cleveland
Perkins Machine & Gear Co., Springfield, Mass.
Philadelphia Gear Works, Philadelphia
Stahl Gear & Machine Co., Cleveland

GEARS, Master
Earle Gear & Mach. Co., Philadelphia
Fellows Gear Shaper Co., Springfield, Vt.
Illinois Tool Works, Chicago
Michigan Tool Co., Detroit
National Broach & Mach. Co., Detroit
National Tool Co., Cleveland
Pratt & Whitney Div., Niles-Bement-Pond Co., Hartford, Conn.

GEARS, Non-Metallic
Adams Co., Dubuque, Iowa
Bakelite Corp., N. Y. C.
Bilgram Gear & Mach. Wks., Philadelphia
Braun Gear Co.p., Brooklyn, N. Y.
Earle Gear & Machine Co., Philadelphia
Farrel-Birmingham Co., Buffalo, N. Y.
Ganschow Gear Co., Chicago
Gear Specialties, Inc., Chicago
General Electric Co., Schenectady, N. Y.
Grant Gear Works Inc., Boston
Hartford Special Machinery Co., Hartford, Conn.
Meisel Press Mfg. Co., Boston
Perkins Machine & Gear Co., Springfield, Mass.
Philadelphia Gear Works, Philadelphia
Stahl Gear & Machine Co., Cleveland
Taylor Machine Co., Cleveland
Westinghouse Elec. & Mfg. Co., E. Pittsburgh

GOGGLES, Face Shields & Sweat Bands
American Optical Co., Southbridge, Mass.

GRAINS, Abrasive
Bay State Abrasive Prod. Co., Westboro, Mass.
Carborundum Co., Niagara Falls, N. Y.
Norton Co., Worcester, Mass.
Sterling Grinding Wheel Div., Tiffin, O.

GRINDERS, Abrasive-Belt
Delta Mfg. Co., Milwaukee
Hammond Machinery Bldrs., Inc., Kalamazoo, Mich.
Mattison Machine Works, Rockford, Ill.
Porter Cable Mach. Co., Syracuse, N. Y.
Pratt & Whitney Div., Niles-Bement-Pond Co., Hartford, Conn.
Production Mach. Co., Greenfield, Mass.
Walker-Turner Co., Inc., Plainfield, N. J.
Wails Sales Corp., N. Y. C.

GRINDERS, Bench & Pedestal
Atlas Press Co., Kalamazoo, Mich.
Black & Decker Mfg. Co., Towson, Md.
Blount Co., J. G., Everett, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Bryant Machinery & Engrg. Co., Chicago
Delta Mfg. Co., Milwaukee
Hammond Machinery Bldrs., Inc., Kalamazoo, Mich.
Hardinge Brothers, Inc., Elmira, N. Y.
Hobart Brothers, Troy, Ohio
Norton Co., Worcester, Mass.
Porter Cable Mach. Co., Syracuse, N. Y.
Pratt & Whitney Div., Niles-Bement-Pond Co., Hartford, Conn.
Queen City Machine Tool Co., Cincinnati
Schauer Machine Co., Cincinnati
Stow Mfg. Co., Binghamton, N. Y.
Union Twist Drill Co., Athol, Mass.
Vonnegut Moulder Corp., Indianapolis
Walker Co., O. S., Worcester, Mass.
Walker-Turner Co., Plainfield, N. J.
Wails Sales Corp., N. Y. C.

GRINDERS, Cam
Landis Tool Co., Waynesboro, Pa.
Norton Co., Worcester, Mass.

GRINDERS, Carbide Tool
Blount Co., J. G., Everett, Mass.
Excello Corp., Detroit
Hammond Machinery Bldrs., Inc., Kalamazoo, Mich.

GRINDERS, Centerless
Cincinnati Grinders, Inc., Cincinnati
Heald Machine Co., Worcester, Mass.
Metal Carbides Corp., Youngstown, O.

GRINDERS, Chucking
Blanchard Machine Co., Cambridge, Mass.
Bryant Chucking Grinder Co., Springfield, Vt.
Fitchburg Grinding Mach. Corp., Fitchburg, Mass.
Heald Machine Co., Worcester, Mass.
Landis Tool Co., Waynesboro, Pa.

GRINDERS, Contour
Baker Bros., Inc., Toledo, Ohio
Blanchard Machine Co., Cambridge, Mass.
Thompson Grinder Co., Springfield, O.

GRINDERS, Cutter & Tool
Abrasive Mach. Tool Co., E. Providence, R. I.
Barber-Colman Co., Rockford, Ill.
Blount Co., J. G., Everett, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Bryant Chucking Grinder Co., Springfield, Vt.
Carboloy Co., Inc., Detroit
Cincinnati Milling Mach. Co., Cincinnati
Continental Machines, Inc., Minneapolis
Covel Mfg. Co., Benton Harbor, Mich.
Delta Mfg. Co., Milwaukee
Ex-Cell-O Corp., Detroit
Fellows Gear Shaper Co., Springfield, Vt.
Fitchburg Grinding Machine Corp., Fitchburg, Mass.
Gallmeyer & Livingston Co., Grand Rapids, Mich.
General Machinery Corp., Boston
Geometric Tool Co., New Haven, Conn.
Gorton Machine Co., Geo., Racine, Wis.
Hammond Machinery Builders, Inc., Kalamazoo, Mich.
Heald Machine Co., Worcester, Mass.
Kearney & Trecker Co., Milwaukee
Landis Machine Co., Waynesboro, Pa.
Landis Tool Co., Waynesboro, Pa.
LeBlond Mach. Tool Co., R. K., Cincinnati
National Acme Co., Cleveland
Norton Co., Worcester, Wass.
Oliver Instrument Co., Adrian, Mich.
Pratt & Whitney Div., Niles-Bement-Pond Co., Hartford, Conn.
Production Mach. Co., Greenfield, Mass.
Scherr Co., Inc., Geo., N. Y. C.
Sellers & Co., Inc., Wm., Philadelphia
Standard Tool Co., Cleveland
Sundstrand Mach. Tool Co., Rockford, Ill.
Thompson Grinder Co., Springfield, O.
Union Twist Drill Co., Athol, Mass.
Walker Co., O. S., Worcester, Mass.

GRINDERS, Cylindrical
Arter Grinding Mach. Co., Worcester, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Bryant Chucking Grinder Co., Springfield, Vt.
Cincinnati Grinders, Inc., Cincinnati
Dumore Co., Racine, Wis.
Farrel-Birmingham Co., Ansonia, Conn.
Fitchburg Grinding Machine Corp., Fitchburg, Mass.
Heald Machine Co., Worcester, Mass.
Landis Tool Co., Waynesboro, Pa.
Lempco Products, Inc., Bedford, O.
Morse Twist Drill & Machine Co., New Bedford, Mass.
Norton Co., Worcester, Mass.
Thompson Grinder Co., Springfield, O.

GRINDERS, Disk
Delta Mfg. Co., Milwaukee
Fitchburg Grinding Machine Corp., Fitchburg, Mass.
Gardner Machine Co., Beloit, Wis.
Hammond Machinery Bldrs., Inc., Kalamazoo, Mich.
Lempco Products, Inc., Bedford, O.
Porter Cable Mach. Co., Syracuse, N. Y.
Pratt & Whitney Div., Niles-Bement-Pond Co., Hartford, Conn.
Production Mach. Co., Greenfield, Mass.
Queen City Mach. Tool Co., Cincinnati
Wails Sales Corp., N. Y. C.

GRINDERS, Drill & Tap
Blake Co., Edward, Newton Center, Mass.
Covel Mfg. Co., Benton Harbor, Mich.
Gallmeyer & Livingston Co., Grand Rapids, Mich.
Hammond Machinery Bldrs., Inc., Kalamazoo, Mich.
Oliver Instrument Co., Adrian, Mich.
Sellers & Co., Wm., Philadelphia
Union Twist Drill Co., Athol, Mass.

GRINDERS, Face or Ring Wheel
Abrasive Mach. Tool Co., E. Providence, R. I.
Blanchard Machine Co., Cambridge, Mass.
Blount Co., J. G., Everett, Mass.
Bridgeport Safety Emery Wheel Co., Bridgeport, Conn.
Bryant Chucking Grinder Co., Springfield, Vt.
Cincinnati Bickford Tool Co., Oakley, Cincinnati
Hammond Machinery Bldrs., Inc., Kalamazoo, Mich.
Lempco Products, Inc., Bedford, O.

GRINDERS, Gear
Fitchburg Grinding Machine Corp., Fitchburg, Mass.
Gear Grinding Machine Co., Detroit
Gleason Works, Rochester, N. Y.
Lees-Bradner Co., Cleveland
Pratt & Whitney Div., Niles-Bement-Pond Co., Hartford, Conn.

GRINDERS, Internal
Arter Grinding Mach. Co., Worcester, Mass.
Bryant Chucking Grinder Co., Springfield, Vt.
Fitchburg Grinding Machine Corp., Fitchburg, Mass.
Hartford Special Machinery Co., Hartford, Conn.
Heald Machine Co., Worcester, Mass.
Landis Tool Co., Waynesboro, Pa.
Lempco Products, Inc., Bedford, O.
Rivett Lathe & Grinder, Inc., Boston
Sav-Way Tool & Mach. Co., Detroit
Sundstrand Mach. Tool Co., Rockford, Ill.
Thompson Grinder Co., Springfield, O.
Van Norman Machine Tool Co., Springfield, Mass.
Walker Co., O. S., Worcester, Mass.

GRINDERS, Jig
Moore Spec. Tool Co., Bridgeport, Conn.

GRINDERS, Knife & Shear-Blade
Abrasive Mach. Tool Co., E. Providence, R. I.
Arter Grinding Mach. Co., Worcester, Mass.
Atkins & Co., E. C., Indianapolis
Bridgeport Safety Emery Wheel Co., Bridgeport, Conn.
Hill Acme Co., Cleveland
Mattison Machine Works, Rockford, Ill.

GRINDERS, Lathe-Attachment (See ATTACHMENTS, Lathe)

GRINDERS, Portable Electric (See also TOOLS, Portable Electric)
Black & Decker Mfg. Co., Towson, Md.
Chicago Wheel & Mfg. Co., Chicago
Dremel Mfg. Co., Racine, Wis.
Dumore Co., Racine, Wis.
Hammond Machinery Bldrs., Inc., Kalamazoo, Mich.
Haskins Co., R. G., Chicago
Porter-Cable Mach. Co., Syracuse, N. Y.

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No. 3 GREENFIELD MOTOR-IN-HEAD GRINDER

With the attachments furnished, this machine is capable of handling a wide variety of tool room or production work.

While ordinarily furnished either as a plain Cutter and Reamer Grinder or as a Universal Machine, the No. 3 Greenfield can be furnished in any other combination if desired.

Heavy construction makes it an ideal machine for production work. It can be quickly set up for accurate grinding of any work within its capacity.

Condensed Specifications

Swing over table—6¼"
Dist. between centers—21"
Length of Table Travel—19"
Cross feed—6"
Vertical feed—8"
Capacity Cutters on Centers—6¼" dia
Capacity Cutters on Holder—14" dia.
Chuck Capacity—3¾"

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Also manufacturers of Drilling Machines and Hand and Automatic Polishing and Grinding Machines
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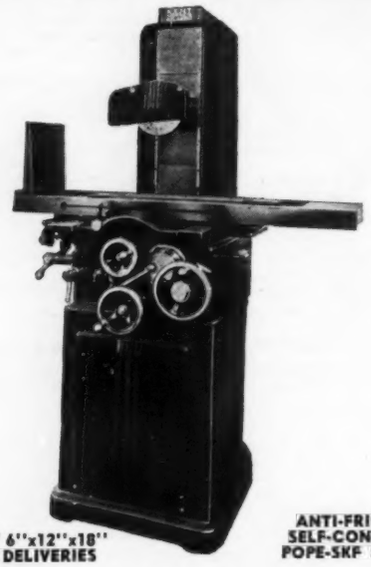
ATLANTIC

No. 2 Automatic Precision Type

SURFACE GRINDER



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ANTI-FRICTION
SELF-CONTAINED
POPE-SKF SPINDLE

ATLANTIC MACHINERY CORP.

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HARDNESS TESTER

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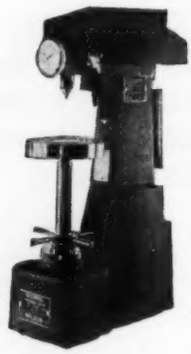

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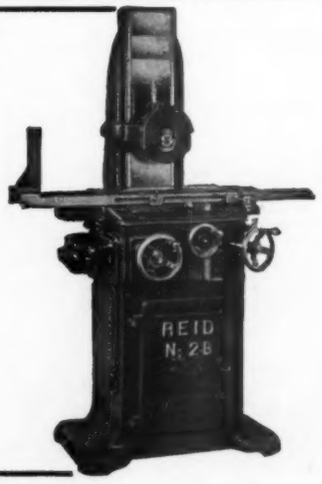

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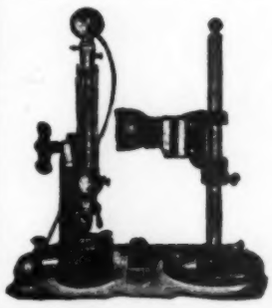

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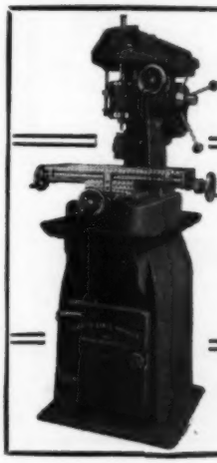

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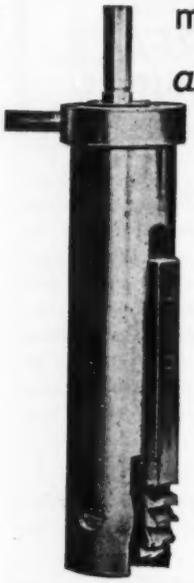

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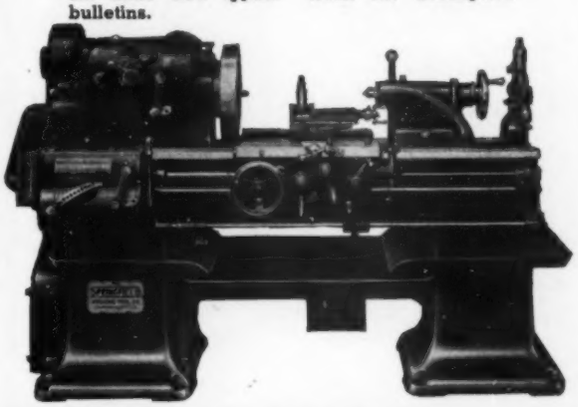
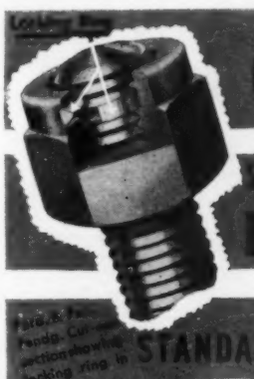
A lathe purchased now . . . for 24 hours a day, 7 days a week operation . . . must still meet your normal peacetime requirements in the future. The flexible, diversified, all-over efficiency of SPRINGFIELD lathes stamps them as ideal for defense and regular production. In all sizes and types. Write for descriptive bulletins.



The SPRINGFIELD MACHINE TOOL Co.
SPRINGFIELD, OHIO, U.S.A.



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STANDARD PRESSED STEEL CO.
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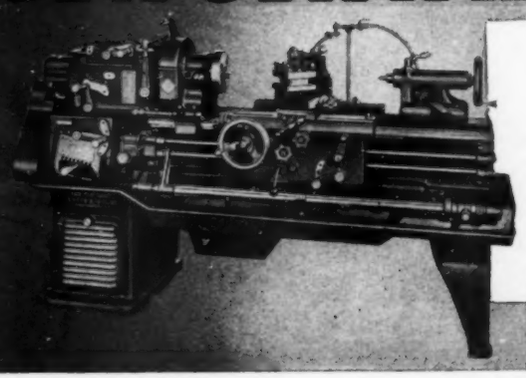
CINCINNATI LATHES



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Accurate in Every Detail

Gears—precision cut, tempered and ground . . . Spindle—mounted on Roller Bearings to resist any combination of thrusts . . . Bed—extra heavy in construction . . . Ways and carriage hand scraped to a precision bearing. These features of Cincinnati Lathes add up to accuracy in every detail that insures precision results on every job. Write for complete specifications of 14" to 30" sizes.

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Disney Drive, Oakley SPECIALISTS SINCE 1906 Cincinnati, Ohio

Streamlined

MARKING

Model 157

Meet today's urgent demand for speed, accuracy and dependability with this new Noblewest Rapid Precision Marking Machine. It combines the famous Noblewest rolling process with new ease of operation and greatly increased production speeds. Users report production increases up to 500% plus sharper, clearer, permanent impressions. Write today for full information.

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Marking Specialists Since 1904

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MARK IT BEST WITH NOBLEWEST® NOBLEWEST IMPROVED MARKING DEVICES

NO. 1 HEAVY DUTY GEARED HEAD HAND MILLER

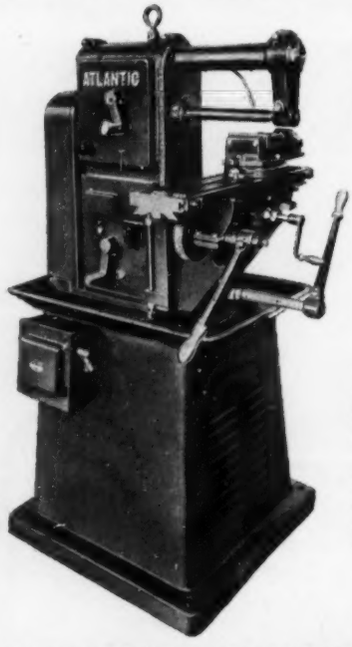

Table: 6"x24"
Capacity 5½"x8½"x18"

Geared Spindle Speeds — 6 forward, 6 reverse. Optional spindle speed ranges available:

150- 675 R.P.M.
200- 900 R.P.M.
350-1350 R.P.M.

ANTI-FRICTION Speed and spendle assemblies.

Built in coolant pump and piping motor in base.

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Moore Mfg. Co., Wm., Chicago
Noble & Westbrook Mfg. Co., East Hartford, Conn.
Numberall Stamp & Tool Co., Huguenot Park, N. Y.

MASKS (See **RESPIRATORS**)

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Barrett Co., Leon J., Worcester, Mass.
Bullard Co., Bridgeport, Conn.
Detroit Rex Products Co., Detroit
Hobart Bros. Co., Troy, O.
Stow Mfg. Co., Inc., Binghamton, N. Y.

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Bunting Brass & Bronze Co., Toledo, O.
Johnson Bronze Co., New Castle, Pa.
Ryerson & Son, Jos. T., Chicago
Westinghouse Electric & Mfg. Co., E. Pittsburgh

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Brown & Sharpe Mfg. Co., Providence, R. I.
Central Tool Co., Auburn, R. I.
Davis & Thompson Co., Milwaukee
Federal Products Corp., Providence, R. I.
Lufkin Rule Co., Saginaw, Mich.
Pratt & Whitney Div., Niles-Bement-Pond Co., Hartford, Conn.
Randall & Stickney, Waltham, Mass.
Scherr Co., Inc., George, N. Y. C.
Slocomb Co., J. T., Providence, R. I.
Starrett Co., L. S., Athol, Mass.
Taft-Peirce Mfg. Co., Woonsocket, R. I.

MICROSCOPES
Scherr Co., Geo., N. Y. C.

MILLERS, Automatic
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Mach. Co., Cincinnati
Consolidated Mach. Tool Corp., Rochester, N. Y.
Fitchburg Engrg. Corp., Fitchburg, Mass.
Kearney & Trecker Corp., Milwaukee
Kent-Owens Machine Co., Toledo, O.
Producto Machine Co., Bridgeport, Conn.
Sundstrand Mach. Tool Co., Rockford, Ill.

MILLERS, Bench
Ames Co., B. C., Waltham, Mass.
Atlas Press Co., Kalamazoo, Mich.
Burke Machine Tool Co., Conneaut, O.
Granite State Mach. Co., Inc., Manchester, N. H.
Hardinge Brothers, Inc., Elmira, N. Y.
Jefferson Mach. Tool Co., Cincinnati
Linley Bros. Co., Bridgeport, Conn.
Pratt & Whitney Div., Niles-Bement-Pond Co., Hartford, Conn.
Producto Machine Co., Bridgeport, Conn.

MILLERS, Duplex
Cincinnati Milling Mach. Co., Cincinnati
Consolidated Mach. Tool Corp., Rochester, N. Y.
Davis & Thompson Co., Milwaukee
Fitchburg Engrg. Corp., Fitchburg, Mass.
General Machinery Corp., Hamilton, O.
Kearney & Trecker Corp., Milwaukee
Producto Machine Co., Bridgeport, Conn.
Sundstrand Mach. Tool Co., Rockford, Ill.
Snyder Tool & Engrg. Co., Detroit
Van Norman Mach. Tool Co., Springfield, Mass.

MILLERS, Hand
Atlantic Machinery Co., N. Y. C.
Brown & Sharpe Mfg. Co., Providence, R. I
Hardinge Brothers, Inc., Elmira, N. Y.
Jefferson Mach. Tool Co., Cincinnati
Kent-Owens Machine Co., Toledo, O.
Lucas & Sons, Inc., J. L., Bridgeport, Conn.
Nichols & Sons, W. H., Waltham, Mass.
Producto Machine Co., Bridgeport, Conn.
Sundstrand Mach. Tool Co., Rockford, Ill.
Van Norman Mach. Tool Co., Springfield, Mass.
Wigglesworth Machine Tool Co., Cambridge, Mass.

MILLERS, Plain & Universal
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Mach. Co., Cincinnati
Douglas Machinery Co., Inc., N. Y. C.
Fray Mach. Tool Co., Glendale, Calif.
Gorton Machine Co., Geo., Racine, Wis.
Granite State Mach. Co., Inc., Manchester, N. H.
Hardinge Brothers, Inc., Elmira, N. Y.
Jefferson Mach. Tool Co., Cincinnati
Kearney & Trecker Corp., Milwaukee
Kempsmith Machine Co., Milwaukee
Kent-Owens Machine Co., Toledo, O.
Lucas & Son, Inc., J. L., Bridgeport, Conn.
Knight Machinery Co., W. B., St. Louis
Machinery Mfg. Co., Chicago
Nichols & Sons, W. H., Waltham, Mass.
Ohio Machine Tool Co., Kenton, O.
Producto Machine Co., Bridgeport, Conn.
Sidney Machine Tool Co., Sidney, O.
Van Norman Machine Tool Co., Springfield, Mass.

MILLERS, Planer Type
Cincinnati Planer Co., Cincinnati
Consolidated Mach. Tool Corp., Rochester, N. Y.
Fitchburg Engrg. Corp., Fitchburg, Mass.
General Machinery Corp., Hamilton, O.
Kearney & Trecker Corp., Milwaukee
Sellers & Co., Inc., Wm., Philadelphia

MILLERS, Planetary
Plan-O-Mill Corp., Royal Oak, Mich.

MILLERS, Profile
Cincinnati Milling Mach. Co., Cincinnati
Consolidated Mach. Tool Corp., Rochester, N. Y.
Gorton Machine Co., Geo., Racine, Wis.
Knight Machinery Co., W. B., St. Louis
Morey Machinery Co., Inc., N. Y. C.
Pratt & Whitney Div., Niles-Bement-Pond Co., Hartford, Conn.
Producto Mach. Co., Bridgeport, Conn.
Reed-Prentice Corp., Worcester, Mass.

MILLERS, Thread
Adams Co., Dubuque, Iowa
Cleveland Auto. Mach. Co., Cleveland
Coulter Mach. Co., Jas., Bridgeport, Conn.
Hanson-Whitney Mach. Co., Hartford, Conn.
Lees-Bradner Co., Cleveland
Plan-O-Mill Corp., Royal Oak, Mich.
Pratt & Whitney Div., Niles-Bement-Pond Co., Hartford, Conn.
Producto Machine Co., Bridgeport, Conn.
Rivett Lathe & Grinder, Inc., Boston
Scherr Co., Inc., Geo., N. Y. C.
Taft-Peirce Mfg. Co., Woonsocket, R. I.
Waltham Mach. Works, Waltham, Mass.

MILLERS, Vertical
Blank & Buxton Machy. Co., Jackson, Mich.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Mach. Co., Cincinnati
Consolidated Mach. Tool Corp., Rochester, N. Y.
Coulter Machine Co., James, Bridgeport, Conn.
General Machinery Corp., Hamilton, O.
Gorton Machine Co., Geo., Racine, Wis.
Granite State Mach. Co., Inc., Manchester, N. H.
Hardinge Bros., Inc., Elmira, N. Y.
Jefferson Mach. Tool Co., Cincinnati
Kearney & Trecker Corp., Milwaukee
Kempsmith Mfg. Co., Milwaukee
Knight Machinery Co., W. B., St. Louis
Linley Bros. Co., Bridgeport, Conn.
Machinery Mfg. Co., Los Angeles
Morey Machinery Co., Inc., N. Y. C.
Pratt & Whitney Div., Niles-Bement-Pond Co., Hartford, Conn.
Producto Machine Co., Bridgeport, Conn.
Reed-Prentice Corp., Worcester, Mass.
Sidney Machine Tool Co., Sidney, O.
Sommer & Adams Co., Cleveland
Sundstrand Mach. Tool Co., Rockford, Ill
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Reed-Prentice Corp., Worcester, Mass.
Watson-Stillman Co., Roselle, N. J.

MOLDS, Lead Hammer
Johnson Tool Co., Inc., E. Providence, R. I.

MOLYBDENUM
Molybdenum Corp. of America, Pittsburgh

MOTORS, Electric
Allis-Chalmers Mfg. Co., Milwaukee
Barber-Colman Co., Rockford, Ill.
Century Electric Co., St. Louis
Dumore Co., Racine, Wis.
General Electric Co., Schenectady, N. Y.
Harnischfeger Corp., Milwaukee
Howell Elec. Motors Co., Howell, Mich.
Lincoln Electric Co., Cleveland
Reliance Elec. & Engrg. Co., Cleveland
Wagner Electric Corp., St. Louis
Wesche Electric Co., B. A., Cincinnati
Westinghouse Elec. & Mfg. Co., E. Pittsburgh

MOTORS, Geared (See **MOTORS, Electric**)

MOTORS, Hydraulic (see also **PUMPS Hydraulic**)
Racine Tool & Mach. Co., Racine, Wis.
Sundstrand Mach. Tool Co., Rockford, Ill.

NAMEPLATES
Acromark Co., Elizabeth, N. J.
Matthews & Co., Jas. H., Pittsburgh
Noble & Westbrook Mfg. Co., Hartford, Conn.

NIBBLERS
Campbell, Andrew C., Div. Amer. Chain & Cable Co., Bridgeport, Conn.
Mitts & Merrill, Saginaw, Mich.
Savage Tool Co., Savage, Minn.

NOZZLES, Blast-Cleaning
Littell Machine Co., F. J., Chicago
Norton Company, Worcester, Mass.
Schrader's Sons, A., N. Y. C.

NUMBERING MACHINES (See **MARKING MACHINES**)

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National Acme Co., Cleveland
Potter & Johnston Machine Co., Pawtucket, R. I.

OIL STONES (See **STONES, Sharpening**)

OILERS, Automatic (See **LUBRICATING SYSTEMS**)

OILS, Cutting
Cities Service Co., N. Y. C.
Gulf Oil Corp., Pittsburgh
Houghton & Co., E. F., Philadelphia
Racine Tool & Mach. Co., Racine, Wis.
Shell Oil Co., Inc., N. Y. C.
Sinclair Refining Co., N. Y. C.
Socony-Vacuum Oil Co., N. Y. C.
Standard Oil Co. (Ind.), Chicago
Stuart Oil Co., D. A., Chicago
Sun Oil Co., Philadelphia
Texas Co., N. Y. C.
Tidewater Associated Oil Co., N. Y. C.
White & Bagley Co., Worcester, Mass.

OILS & GREASES (See **LUBRICANTS**)

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Houghton & Co., E. F., Philadelphia
Shell Oil Co., Inc., N. Y. C.
Sinclair Refining Co., N. Y. C.
Socony-Vacuum Oil Co., N. Y. C.
Standard Oil Co. (Ind.), Chicago
Stuart Oil Co., D. A., Chicago
Sun Oil Co., Philadelphia
Texas Co., N. Y. C.
Tidewater Oil Co., N. Y. C.

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Greene, Tweed & Co., N. Y. C.
Houghton & Co., E. F., Philadelphia
Hydraulic Press Mfg. Co., Mt. Gilead, O.
Watson-Stillman Co., Roselle, N. J.

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Sisalkraft Co., Chicago

PAPER & CLOTH, Abrasive
Behr-Manning Corp., Troy, N. Y.
Carborundum Co., Niagara Falls, N. Y.
Midwest Abrasive Co., Detroit

PARALLELS
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Starrett Co., L. S., Athol, Mass.
Taft-Peirce Mfg. Co., Woonsocket, R. I.
Walker Co., O. S., Worcester, Mass.

PHOSPHOR BRONZE
Bunting Brass & Bronze Co., Toledo
Johnson Bronze Co., New Castle, Pa.

PICKLING MACHINES (See **METAL-CLEANING EQUIPMENT**)

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Allen Mfg. Co., Hartford, Conn.
American Steel & Wire Co., Cleveland
Bethlehem Steel Co., Bethlehem, Pa.
Danly Machine Specialties, Inc., Chicago
Morse Twist Drill & Machine Co., New Bedford, Mass.
Pratt & Whitney Div., Niles-Bement-Pond Co., Hartford, Conn.
Standard Tool Co., Cleveland

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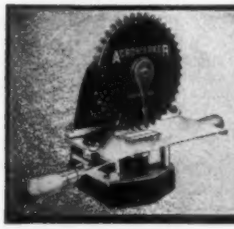
Bardons & Oliver, Inc., Cleveland
Cleveland Automatic Mach. Co., Cleveland
Hill Acme Co., Cleveland
Landis Mach. Co., Waynesboro, Pa.
Murchey Machine & Tool Co., Detroit
Oster Mfg. Co., Cleveland
Peerless Machine Co., Racine, Wis.
Rickert-Shafer Co., Erie, Pa.
Scherr Co., Inc., Geo., N. Y. C.
Warner & Swasey Co., Cleveland

PLANERS
Cincinnati Planer Co., Cincinnati
The Cleveland Planer, Cleveland
Cleveland Punch & Shear Works Co., Cleveland
Consolidated Mach. Tool Corp., Rochester, N. Y.
General Machinery Corp., Hamilton, O.
Liberty Planers, Inc., Hamilton, O.
Ohio Machine Tool Co., Kenton, O.
Rockford Mach. Tool Co., Rockford, Ill.
Sellers & Co., Inc., Wm., Philadelphia

PLANERS, Plate
Baldwin-Southwark Corp., Philadelphia
Cleveland Punch & Shear Works Co., Cleveland
Consolidated Mach. Tool Corp., Rochester, N. Y.
General Machinery Corp., Hamilton, O.
Ohio Machine Tool Co., Kenton, O.
Sellers & Co., Wm., Philadelphia



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BURKE MILLING MACHINES

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All Types—for Heavy Duty Service

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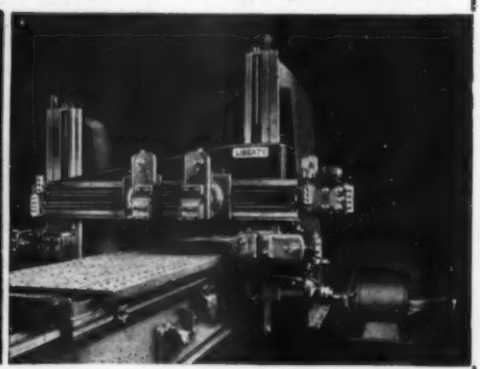

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for heavy blanking and forming

Heavier classes of blanking and forming work can be handled efficiently and economically on these presses.

Sturdily constructed with either solid frame or built up with tie rods. Small elastic deflections do not affect tool alignment. All stresses taken centrally. Made also with wedge adjustment for slide for very close work.

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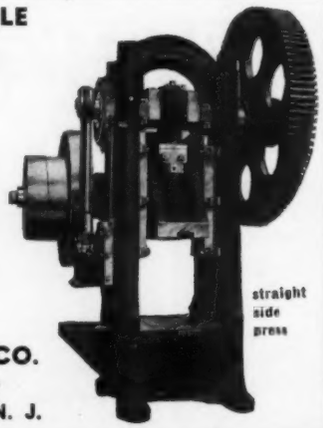

straight side press

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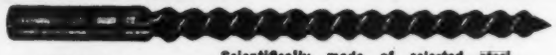

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AUTOMATIC EQUIPMENT

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Pratt & Whitney Div., Niles-Bement-Pond Co., Hartford, Conn.
Starrett Co., L. S., Athol, Mass.
Taft-Peirce Mfg. Co., Woonsocket, R. I.

PLATES, Surface
Baumbach Mfg. Co., E. A., Chicago
Brown & Sharpe Mfg. Co., Providence, R. I.
Delta Mfg. Co., Milwaukee
Lombard Governor Corp., Ashland, Mass.
Machine Products Corp., Detroit
Pratt & Whitney Div., Niles-Bement-Pond Co., Hartford, Conn.
Starrett Co., L. S., Athol, Mass.
Taft-Peirce Mfg. Co., Woonsocket, R. I.

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General Electric Co., Schenectady, N. Y.

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General Electric Co., Schenectady, N. Y.
Hones, Inc., Chas. A., Baldwin, N. Y.
Strong, Carlisle & Hammond Co., Cleveland
Westinghouse Electric & Mfg. Co., E. Pittsburgh, Pa.

PRESSES, Arbor
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Atlas Press Co., Kalamazoo, Mich.
Barnes Co., W. F. & John, Rockford, Ill.
Elmes Engrg. Wks., Chas. F., Chicago
Famco Machine Co., Racine, Wis.
Hydraulic Press Mfg. Co., Mt. Gilead, O.
Lempco Products, Inc., Bedford, O.
Lucas Machine Tool Co., Cleveland
Nicholson & Co., W. H., Wilkes-Barre, Pa.
Producto Machine Co., Bridgeport, Conn.
Sheldon Machine Co., Chicago
Tomkins-Johnson Co., Jackson, Mich.
Watson-Stillman Co., Roselle, N. J.
Wilson, K. R., Buffalo, N. Y.
Wright Mfg. Div., American Chain & Cable Co., York, Pa.

PRESSES, Crank (See **PRESSES, Power**)

PRESSES, Foot
Etna Machine Co., Toledo, O.
Famco Machine Co., Racine, Wis.
Ferracute Machine Co., Bridgeton, N. J.
Niagara Mach. & Tool Wks., Buffalo, N. Y.
Nilson Mach. Co., A. H., Bridgeport, Conn
V. & O. Press Co., Hudson, N. Y.

PRESSES, Forging
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Baldwin-Southwark Corp., Philadelphia
Beatty Mach. & Mfg. Co., Hammond, Ind.
Bethlehem Steel Co., Bethlehem, Pa.
Clearing Machine Corp., Chicago
Cleveland Punch & Shear Works Co., Cleveland
Elmes Engrg. Wks., Chas. F., Chicago
Hill Acme Co., Cleveland
Hydraulic Press Mfg. Co., Mt. Gilead, O
Niagara Mach. & Tool Wks., Buffalo, N. Y.
Watson-Stillman Co., Roselle, N. J.
Zeh & Hahnemann Co., Newark, N. J.

PRESSES, Hydraulic
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Atlas Press Co., Kalamazoo, Mich.
Baldwin-Southwark Corp., Philadelphia
Beatty Mach. & Mfg. Co., Hammond, Ind.
Bethlehem Steel Co., Bethlehem, Pa.
Clearing Machine Corp., Chicago
Davis Keyseater Co., Rochester, N. Y.
Elmes Engrg. Wks., Chas. F., Chicago
Farrel-Birmingham Co., Ansonia, Conn.
General Machinery Corp., Hamilton, O.
Hydraulic Press Mfg. Co., Mt. Gilead, O.
Lapointe Mach. Tool Co., Hudson, Mass.
Lempco Products, Inc., Bedford, O.
Tomkins-Johnson Co., Jackson, Mich.
Watson-Stillman Co., Roselle, N. J.
Wright Mfg. Div. Amer. Chain Co. Inc., Bridgeport, Conn.

PRESSES, Power (Punch)
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Buffalo Forge Co., Buffalo, N. Y.
Cincinnati Shaper Co., Cincinnati
Clearing Mach. Co., Chicago
Cleveland Crane & Engrg. Co., Steelweld Machry. Div., Wickliffe, Ohio
Cleveland Punch & Shear Works Co., Cleveland
Consolidated Machine Tool Corp., Rochester, N. Y.
Davis Keyseater Co., Rochester, N. Y.
Federal Press Co., Elkhart, Ind.
Ferracute Machine Co., Bridgeton, N. J.
Hendey Machine Co., Torrington, Conn.
Henry & Wright Mfg. Co., Hartford, Conn.
Hydraulic Press Mfg. Co., Mt. Gilead, O.
Kent-Owens Machine Co., Toledo, O.
Lempco Products, Inc., Bedford, O.
Mitts & Merrill, Saginaw, Mich.
Niagara Mach. & Tool Wks., Buffalo, N. Y.
Nilson Mach. Co., A. H., Bridgeport, Conn.
Ryerson & Son, Inc., Jos. T., Chicago
Schatz Mfg. Co., Poughkeepsie, N. Y.
V. & O. Press, Hudson, N. Y.
Wiedemann Machine Co., Philadelphia
Zeh & Hahnemann Co., Newark, N. J.

PRESSES, Screw
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Ferracute Machine Co., Bridgeton, N. J.
Niagara Mach. & Tool Wks., Buffalo, N. Y.
Producto Mach. Co., Bridgeport, Conn.
Schatz Mfg. Co., Poughkeepsie, N. Y.
Wright Mfg. Div., American Chain & Cable Co., York, Pa.
Zeh & Hahnemann Co., Newark, N. J.

PRESSES, Straightening
Baldwin-Southwark Corp., Philadelphia
Cleveland Punch & Shear Works Co., Cleveland
Consolidated Machine Tool Corp., Rochester, N. Y.
Elmes Engrg. Wks., Chas. F., Chicago
Hydraulic Press Mfg. Co., Mt. Gilead, O.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Nilson Mach. Co., A. H., Bridgeport, Conn.
Springfield Mach. Tool Co., Springfield, O.
Watson-Stillman Co., Roselle, N. J.

PRESSES, Turret Punch
Federal Press Co., Elkhart, Ind.
Wiedemann Machine Co., Philadelphia

PROFILERS (See **MILLERS, Vertical**)

PROJECTORS, Contour
Jones & Lamson Machine Co., Springfield, Vt.
Portman Machine Tool Co., Mt. Vernon, N. Y.
Scherr Co., Geo., N. Y. C.

PROTRACTORS, Optical
Scherr Co., Geo., N. Y. C.

PULLEYS, Iron, Steel & Wood
American Pulley Co., Philadelphia
Brown & Sharpe Mfg. Co., Providence, R. I.
Carlyle Johnson Machine Co., Manchester, Conn.
Dayton Rubber Mfg. Co., Dayton, O.
Hill-Acme Co., Cleveland
Reeves Pulley Co., Columbus, Ind.

PULLEYS, V-Belt (See **SHEAVES, V-Belt**)

PUMPS, Centrifugal
Allis-Chalmers Mfg. Co., Milwaukee
Brown & Sharpe Mfg. Co., Providence, R. I.
Pioneer Engrg. & Mfg. Co., Detroit
Ruthman Machry. Co., Cincinnati
Tomkins-Johnson Co., Jackson, Mich.

PUMPS, Hydraulic
Allis-Chalmers Mfg. Co., Milwaukee
Baldwin-Southwark Corp., Philadelphia
Barnes Co., W. F. & John, Rockford, Ill.
Elmes Engrg. Wks., Chas. F., Chicago
Hydraulic Press Mfg. Co., Mt. Gilead, O.
Lapointe Mach. Tool Co., Hudson, Mass.
Racine Tool & Mach. Co., Racine, Wis.
Sundstrand Mach. Tool Co., Rockford, Ill.
Tuthill Pump Co., Chicago
Watson-Stillman Co., Roselle, N. J.

WHERE-TO-BUY DIRECTORY

PUMPS, Lubricant and Coolant
Brown & Sharpe Mfg. Co., Providence, R. I.
Buffalo Forge Co., Buffalo, N. Y.
Pioneer Engrg. & Mfg. Co., Detroit
Rivett Lathe & Grinder, Inc., Boston
Ruthman Machinery Co., Cincinnati
Sundstrand Mach. Tool Co., Rockford, Ill.
Tomkins-Johnson Co., Jackson, Mich.
Tuthill Pump Co., Chicago

PUNCHES, Center & Hand (See **TOOLS, Hand**)

PURIFIERS, Oil & Coolant
Barrett Co., Leon J., Worcester, Mass.
DeLaval Separator Co., N. Y. C.

PYROMETERS, Indicating & Recording
Brown Instrument Co., Philadelphia

QUENCHERS
American Gas Furn. Co., Elizabeth, N. J.
Electric Furnace Co., Salem, O.
Farrel-Birmingham Co., Buffalo, N. Y.
Gleason Works, Rochester, N. Y.

RACKS, Gear (See **GEARS, Cut**)

RASPS (See **FILES & RASPS**)

RATCHETS (See **GEARS, Cut**)

REAMERS, Adjustable
Barber-Colman Co., Rockford, Ill.
Butterfield & Co., Derby Line, Vt.
Carboloy Co., Detroit
Cleveland Twist Drill Co., Cleveland
Gairing Tool Co., Detroit
Gisholt Machine Co., Madison, Wis.
Greenfield Tap & Die Corp., Greenfield, Mass.
McCrosky Tool Corp., Meadville, Pa.
Michigan Tool Co., Detroit
Morse Twist Drill & Mach. Co., New Bedford, Mass.
National Tool Co., Cleveland
Pratt & Whitney Div., Niles-Bement-Pond Co., Hartford, Conn.
Scully-Jones & Co., Chicago
Standard Tool Co., Cleveland
Taft-Peirce Mfg. Co., Woonsocket, R. I.
Union Twist Drill Co., Athol, Mass.

REAMERS, Pipe
American Swiss File & Tool Co., Elizabeth, N. J.
Armstrong Bros. Tool Co., Chicago
Butterfield & Co., Derby Line, Vt.
Card Mfg. Co., S. W., Mansfield, Mass.
Cleveland Twist Drill Co., Cleveland
Detroit Tap & Tool Co., Detroit
Gairing Tool Co., Detroit
Greenfield Tap & Die Corp., Greenfield, Mass.
Michigan Tool Co., Detroit
Morse Twist Drill & Machine Co., New Bedford, Mass.
National Twist Drill & Tool Co., Detroit
Oster Mfg. Co., Cleveland
Standard Tool Co., Cleveland
Torrington Co., Torrington, Conn.

REAMERS, Shell
Butterfield & Co., Derby Line, Vt.
Carboloy Co., Inc., Detroit
Cleveland Twist Drill Co., Cleveland
Greenfield Tap & Die Corp., Greenfield, Mass.
Illinois Tool Works, Chicago
Morse Tool Co., Detroit
Morse Twist Drill & Machine Co., New Bedford, Mass.
National Twist Drill & Tool Co., Detroit
Pratt & Whitney Div., Niles-Bement-Pond Co., Hartford, Conn.
Schultz & Anderson Co., Newark, N. J.
Union Twist Drill Co., Athol, Mass.

REAMERS, Solid
Barber-Colman Co., Rockford, Ill.
Butterfield & Co., Derby Line, Vt.
Carboloy Co., Inc., Detroit
Cleveland Twist Drill Co., Cleveland
Detroit Tap & Tool Co., Detroit
Ex-Cell-O Corp., Detroit
Firth-Sterling Steel Co., McKeesport, Pa.
Gairing Tool Co., Detroit
Gisholt Machine Co., Madison, Wis.
Greenfield Tap & Die Corp., Greenfield, Mass.
Haynes Stellite Co., N. Y. C.
Holman Reamer Co., Manchester, Conn.
Illinois Tool Works, Chicago
Michigan Tool Co., Detroit
Morse Twist Drill & Mach. Co., New Bedford, Mass.
National Tool Co., Cleveland
National Twist Drill & Tool Co., Detroit
Pratt & Whitney Div., Niles-Bement-Pond Co., Hartford, Conn.
Scully-Jones & Co., Chicago
Standard Tool Co., Cleveland
Taft-Peirce Mfg. Co., Woonsocket, R. I.
Union Twist Drill Co., Athol, Mass.
Vascoloy-Ramet Corp., N. Chicago, Ill.
Wendt Sonis Co., Hannibal, Mo.

REAMING MACHINES
Blanchard Machine Co., Cambridge, Mass.
Barnes Co., W. F. & John, Rockford, Ill.
Cleveland Pneu. Tool Co., Cleveland
Rotor Tool Co., Cleveland
Van Norman Machine Tool Co., Springfield, Mass.

RECORDERS, Speed (See **INDICATORS, Speed**)

RECORDERS, Temperature & Pressure
Brown Instrument Co., Philadelphia

REDUCERS, Motorized Speed
Adams Co., Dubuque, Iowa
Allis-Chalmers Mfg. Co., Milwaukee
Barber-Colman Co., Rockford, Ill.
Dumore Co., Racine, Wis.
Earle Gear & Machine Co., Philadelphia
Foote Bros. Gear & Mach. Co., Chicago
Ganschow Gear Co., Chicago
Gear Specialties, Inc., Chicago
General Electric Co., Schenectady, N. Y.
Meisel Press Mfg. Co., Boston, Mass.
Ohio Gear Co., Cleveland
Philadelphia Gear Works, Philadelphia
Reliance Elec. & Engrg. Co., Cleveland
Wagner Electric Corp., St. Louis
Westinghouse Elec. & Mfg. Co., E. Pittsburgh

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RA7	4.30	1-5/16—1-21/32	11	3
RA8	4.80	1-11/16—2	12	4
RA9	5.40	2-1/16—2-1/2	13	4

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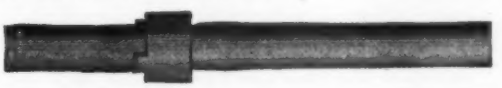

Number	Price Each	Fitting Size Reamer	Length Overall Inches
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RA7	3.60	1-5/16—1-21/32	11
RA8	4.00	1-11/16—2	12
RA9	4.50	2-1/16—2-1/2	13

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Davis & Thompson Co., Milwaukee
Earle Gear & Machine Co., Philadelphia
Farrel-Birmingham Co., Buffalo, N. Y.
Ganschow Gear Co., Chicago
Gear Specialties, Inc., Chicago
General Electric Co., Schenectady, N. Y.
General Machinery Corp., Hamilton, O.
Grant Gear Works, Inc., Boston
Morse Chain Co., Ithaca, N. Y.
Ohio Gear Co., Cleveland
Philadelphia Gear Works, Philadelphia
Racine Tool & Mach. Co., Racine, Wis.
Stahl Gear & Machine Co., Cleveland
Sundstrand Mach. Tool Co., Rockford, Ill.
Watson-Stillman Co., Roselle, N. J.
Westinghouse Elec. & Mfg. Co., E. Pittsburgh, Pa.

REELS, Strip-Stock & Wire
American Pulley Co., Philadelphia
Littell Machine Co., F. J., Chicago
Nilson Mach. Co., A. H., Bridgeport, Conn.
Yoder Co., Cleveland

REFRACTORIES
Bay State Abrasive Products Co., Westboro, Mass.
Carborundum Co., Niagara Falls, N. Y.
Norton Co., Worcester, Mass.
Strong, Carlisle & Hammond Co., Cleveland

REGULATORS, Temperature
American Gas Furn. Co., Elizabeth, N. J.
Barber-Colman Co., Rockford, Ill.
Brown Instrument Co., Philadelphia

RIFLING MACHINES, Gun
American Broach & Machine Co., Ann Arbor, Mich.
Illinois Tool Works, Chicago
LeBlond Mach. Tool Co., R. K., Cincinnati
Pratt & Whitney Div., Niles-Bement-Pond Co., Hartford, Conn.

RIVETERS, Electric Power
Buffalo Forge Co., Buffalo, N. Y.
Grant Mfg. & Mach. Co., Bridgeport, Conn.
Linley Bros. Co., Bridgeport, Conn.
Tomkins-Johnson Co., Jackson, Mich.

RIVETERS, Pneumatic & Hydraulic
Baldwin-Southwark Corp., Philadelphia
Cleveland Pneu. Tool Co., Cleveland
Elmes Engrg. Wks., Chas. F., Chicago
Niagara Mach. & Tool Wks., Buffalo, N. Y.
Watson-Stillman Co., Roselle, N. J.

RIVETS
Aluminum Co. of America, Pittsburgh
American Steel & Wire Co., Pittsburgh
Bethlehem Steel Co., Bethlehem, Pa.
Lamson & Sessions Co., Cleveland

ROLLS, Bending
Baldwin-Southwark Corp., Philadelphia
Buffalo Forge Co., Buffalo, N. Y.
Cleveland Punch & Shear Works Co., Cleveland
Consolidated Machine Tool Corp., Rochester, N. Y.
General Machinery Corp., Hamilton, O.
Niagara Mach. & Tool Wks., Buffalo, N. Y.
Ryerson & Son, Inc., Jos. T., Chicago

ROLLS, Forging
Ajax Mfg. Co., Cleveland
Bethlehem Steel Co., Bethlehem, Pa.

ROPE, Wire
American Cable Div. of Am. Chain & Cable Co., N. Y. C.
Bethlehem Steel Co., Bethlehem, Pa.
Page Steel & Wire Div., Am. Chain & Cable Co., Monessen, Pa.
Roebling's Sons Co., John A., Trenton, N. J.
Ryerson & Son, Inc., Jos. T., Chicago

ROUTERS
Consolidated Mach. Tool Corp., Rochester, N. Y.
Gorton Machine Co., Geo., Racine, Wis.
Knight Machy. Co., W. B., St. Louis
Onsrud Machine Works, Chicago
Reed-Prentice Corp., Worcester, Mass.

RULES, Machinists'
Brown & Sharpe Mfg. Co., Providence, R. I.
Lufkin Rule Co., Saginaw, Mich.
Starrett Co., L. S., Athol, Mass.

RUSTPROOFING & SLUSHING COMPOUNDS
Bakelite Corp., N. Y. C.
Gulf Oil Corp., Pittsburgh
Houghton & Co., E. F., Philadelphia
Oakite Products Co., N. Y. C.
Socony-Vacuum Oil Co., Inc., N. Y. C.
Standard Oil Co. of Indiana, Chicago
Tidewater Oil Co., N. Y. C.

SAFETY EQUIPMENT
American Optical Co., Southbridge, Mass.
Littleford Bros., Cincinnati

SANDERS, Machine & Portable
Black & Decker Mfg. Co., Towson, Md.
Carborundum Co., Niagara Falls, N. Y.
Delta Mfg. Co., Milwaukee
Haskins Co., R. G., Chicago
Jefferson Machine Tool Co., Cincinnati
Mattison Machine Works, Rockford, Ill.
Porter-Cable Mach. Co., Syracuse, N. Y.
Production Mach. Co., Greenfield, Mass.
Rotor Tool Co., Cleveland
Skilsaw, Inc., Chicago
Stow Mfg. Co., Binghamton, N. Y.
Strand Co., N. A., Chicago
Walker-Turner Co., Plainfield, N. J.
Walls Sales Corp., N. Y. C.

SAW BLADES, Circular Metal-Cutting
Atkins & Co., E. C., Indianapolis
Barber-Colman Co., Rockford, Ill.
Brown & Sharpe Mfg. Co., Providence, R. I.
Butterfield & Co., Derby Line, Vt.
Carboloy Co., Inc., Detroit
Disston & Sons, Inc., Henry, Tacony, Philadelphia
Illinois Tool Works, Chicago
Michigan Tool Co., Detroit
Morse Twist Drill & Mach. Co., New Bedford, Mass.
National Twist Drill & Tool Co., Detroit
Pratt & Whitney Div., Niles-Bement-Pond Co., Hartford, Conn.
Standard Tool Co., Cleveland

SAW BLADES, Hack & Band (See **BLADES, Hack & Band-Saw**)

SAWS, Band, Metal-Cutting (Machines)
Armstrong-Blum Mfg. Co., Chicago
Atkins & Co., E. C., Indianapolis
Avey Drilling Mach. Co., Cincinnati
Capewell Mfg. Co., Hartford, Conn.
Continental Machines, Inc., Minneapolis
Delta Mfg. Co., Milwaukee
Kalamazoo Tank & Silo Co., Kalamazoo, Mich.
Peerless Machine Co., Racine, Wis.
Racine Tool & Machine Co., Racine, Wis.
Reed-Prentice Corp., Worcester, Mass.
Ryerson & Son, Inc., Jos. T., Chicago
Starrett Co., L. S., Athol, Mass.
Walker-Turner Co., Plainfield, N. J.

SAWS, Circular, Metal-Cutting (Machines)
Consolidated Mach. Tool Corp., Rochester, N. Y.
Delta Mfg. Co., Milwaukee
Disston & Sons, Inc., Henry, Tacony, Philadelphia
Earle Gear & Machine Co., Philadelphia
Moteh & Merryweather Co., Cleveland
Porter-McLeod Machine Tool Co., Hatfield, Mass.

SAWS, Circular, Wood-Cutting (Machine)
Atkins & Co., E. C., Indianapolis
Curtis Pneumatic Machy. Co., St. Louis
Delta Mfg. Co., Milwaukee
Disston & Sons, Inc., Henry, Tacony, Philadelphia
Mattison Machine Works, Rockford, Ill.
Walker-Turner Co., Inc., Plainfield, N. J.

SAWS, Friction
Ryerson & Son, Inc., Jos. T., Chicago

SAWS, Hack (See **TOOLS, Hand**)

SAWS, Hole
Armstrong-Blum Co., Chicago
Atkins & Co., E. C., Indianapolis
Avey Drilling Mach. Co., Cincinnati
Black & Decker Mfg. Co., Towson, Md.
Earle Gear & Machine Co., Philadelphia
Schrader's Sons, A., N. Y. C.
Skilsaw, Inc., Chicago

SAWS, Portable (See **TOOLS, Portable**)

SAWS, Power Hack
Armstrong-Blum Mfg. Co., Chicago
Atkins & Co., E. C., Indianapolis
Capewell Mfg. Co., Hartford, Conn.
Covel Mfg. Co., Benton Harbor, Mich.
L-W Chuck Co., Toledo, Ohio
Oster Mfg. Co., Cleveland
Peerless Machine Co., Racine, Wis.
Racine Tool & Mach. Co., Racine, Wis.
Ryerson & Son, Inc., Jos. T., Chicago

SCRAPERS, Hand (See **TOOLS, Hand**)

SCRAPERS, Power
Black & Decker Mfg. Co., Towson, Md.

SCREWDRIVERS, Flexible-Shaft (See **TOOLS, Flexible-Shaft**)

SCREWDRIVERS, Hand (See **TOOLS Hand**)

SCREWDRIVERS, Portable Electric & Pneumatic (See **TOOLS, Portable**)

SCREWDRIVING & NUT-SETTING MACHINES
Bodine Corp., Bridgeport, Conn.
Haskins Co., R. G., Chicago
Producto Machine Co., Bridgeport, Conn.
Schauer Machine Co., Cincinnati
Strand & Co., N. A., Chicago

SCREW-MACHINES, Automatic
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Automatic Mach. Co., Cleveland
Cone Automatic Mach. Co., Windsor, Vt.
Foote-Burt Co., Cleveland
Greenlee Bros. & Co., Rockford, Ill.
National Acme Co., Cleveland
New Britain-Gridley Mach. Div., New Britain, Conn.
Scherr Co., Inc., George, N. Y. C.
Warner & Swasey Co., Cleveland

SCREW-MACHINES, Plain & Hand
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Automatic Mach. Co., Cleveland
Gisholt Machine Co., Madison, Wis.
Hardinge Brothers, Inc., Elmira, N. Y.
Jones & Lamson Mach. Co., Springfield, Vt.
National Acme Co., Cleveland
Rivett Lathe & Grinder, Inc., Boston
Warner & Swasey Co., Cleveland

SCREW PLATES (See **DIES, Screw-Cutting, Adjustable**)

SCREWS, Cap and Set
Allen Mfg. Co., Hartford, Conn.
Baumbach Mfg. Co., E. A., Chicago
Danly Machine Specialties, Inc., Chicago
Eastern Machine Screw Corp., New Haven, Conn.
Lamson & Sessions Co., Cleveland
National Acme Co., Cleveland
Parker-Kalon Corp., N. Y. C.
Republic Steel Corp., Cleveland, O.
Standard Pressed Steel Co., Jenkintown, Pa.
Strong, Carlisle & Hammond Co., Cleveland

SCREWS, Machine
Allen Mfg. Co., Hartford, Conn.
Eastern Machine Screw Corp., New Haven, Conn.
Lamson & Sessions Co., Cleveland
Republic Steel Co., Cleveland
Strong, Carlisle & Hammond Co., Cleveland

SCREWS, Recessed Head
American Screw Co., Providence, R. I.
Central Screw Co., Chicago
Chandler Products Corp., Cleveland
Continental Screw Co., New Bedford, Mass.
Corbin Screw Corp., New Britain, Conn.
International Screw Co., Detroit
Lamson & Sessions Co., Cleveland
National Screw & Mfg. Co., Cleveland
New England Screw Co., Keene, N. H.
Parker Co., Charles, Meriden, Conn.
Parker-Kalon Corp., N. Y. C.
Pawtucket Screw Co., Pawtucket, R. I.
Pheoll Mfg. Co., Chicago, Ill.
Phillips Screw Mfrs., Providence, R. I.
Russell, Burdsall & Ward Bolt & Nut Co., Port Chester, N. Y.
Scovill Mfg. Co., Waterbury, Conn.
Shakeproof Lock Washer Co., Chicago
Southington Hardware Mfg. Co., Southington, Conn.
Standard Pressed Steel Co., Jenkintown, Pa.
Whitney Screw Corp., Nashua, N. H.

SCREWS, Self-Tapping
Parker-Kalon Corp., N. Y. C.

SCREWS, Thumb & Wing
Parker-Kalon Corp., N. Y. C.
Williams & Co., J. H., N. Y. C.

SCRIBERS
Brown & Sharpe Mfg. Co., Providence, R. I.
Lufkin Rule Co., Saginaw, Mich.
Starrett Co., L. S., Athol, Mass.

SEALS, Oil
Gits Bros. Mfg. Co., Chicago

SEPARATORS, Centrifugal
Barrett Co., Leon J., Worcester, Mass.
DeLaval Separator Co., N. Y. C.
National Acme Co., Cleveland

SETS, Rivet
American Swiss File & Tool Co., Elizabeth, N. J.
Bethlehem Steel Co., Bethlehem, Pa.
Cleveland Punch & Shear Works Co., Cleveland

SETTERS, Nut (See **TOOLS, Portable**)

SHAFTING, Steel
Bethlehem Steel Co., Bethlehem, Pa.
Earle Gear & Mach. Co., Philadelphia
Jones & Laughlin Steel Corp., Pittsburgh
National Tube Co., Pittsburgh
Ryerson & Son, Inc., Jos. T., Chicago
Scully Steel Products Co., N. Y. C.
Union Drawn Steel Co., Massillon, O.
Wyckoff Drawn Steel Co., Pittsburgh

SHAFTS, Flexible
Dumore Co., Racine, Wis.
Errington Mech. Lab., Stapleton, N. Y.
Haskins Co., R. G., Chicago
Pratt & Whitney Div., Niles-Bement-Pond Co., Hartford, Conn.
Stow Mfg. Co., Binghamton, N. Y.
Strand Co., N. A., Chicago
Walker-Turner Co., Inc., Plainfield, N. J.

SHAPERS
American Tool Works Co., Cincinnati
Ames Co., B. C., Waltham, Mass.
Atkins & Co., E. C., Indianapolis
Atlas Press Co., Kalamazoo, Mich.
Automotive Maintenance Machinery Co., N. Chicago, Ill.
Bryant Machinery & Engrg. Co., Chicago
Cincinnati Shaper Co., Cincinnati
Hanson-Whitney Mach. Co., Hartford, Conn.
Hendey Machine Co., Torrington, Conn.
Machinery Mfg. Co., Los Angeles
Morey Machinery Co., Inc., N. Y. C.
Ohio Machine Tool Co., Kenton, O.
Pratt & Whitney Div., Niles-Bement-Pond Co., Hartford, Conn.
Reed-Prentice Corp., Worcester, Mass.
Rockford Mach. Tool Co., Rockford, Ill.
Smith & Mills Co., Cincinnati

SHARPENERS, Saw
Detroit Tap & Tool Co., Detroit
Ex-Cell-O Corp., Detroit
Fellows Gear Shaper Co., Springfield, Vt.
Michigan Tool Co., Detroit
National Broach & Mach. Co., Detroit
Weldon Tool Co., Cleveland

SHAVING MACHINES
Consolidated Machine Tool Corp., Rochester, N. Y.
Cross Gear & Machine Co., Detroit
Michigan Tool Co., Detroit

SHEARS, Hand
Black & Decker Mfg. Co., Towson, Md.
Buffalo Forge Co., Buffalo, N. Y.
Niagara Mach. & Tool Wks., Buffalo, N. Y.
O'Neil-Irwin Mfg. Co., Minneapolis

WHERE-TO-BUY DIRECTORY

SHEARS, Rotary
Cleveland Punch & Shear Works Co., Cleveland
Consolidated Machine Tool Corp., Rochester, N. Y.
Detroit Tap & Tool Co., Detroit
Disston & Sons, Inc., Henry, Tacony, Philadelphia
Illinois Tool Works, Chicago
Michigan Tool Co., Detroit
Niagara Mach. & Tool Wks., Buffalo, N. Y.
Ryerson & Son, Inc., Jos. T., Chicago
Schatz Mfg. Co., Poughkeepsie, N. Y.

SHEARS, Squaring
Beatty Mach. & Mfg. Co., Hammond, Ind.
Buffalo Forge Co., Buffalo, N. Y.
Cincinnati Shaper Co., Cincinnati
Cleveland Crane & Engrg. Co., Wickliffe, O.
Cleveland Punch & Shear Works Co., Cleveland
Consolidated Machine Tool Corp., Rochester, N. Y.
Kent-Owens Machine Co., Toledo, O.
Mitts & Merrill, Saginaw, Mich.
Niagara Mach. & Tool Wks., Buffalo, N. Y.
Schatz Mfg. Co., Poughkeepsie, N. Y.

SHEAVES, "V" Belt
Allis-Chalmers Mfg. Co., Milwaukee
American Pulley Co., Philadelphia
Dayton Rubber Mfg. Co., Dayton, O.
Earle Gear & Machine Co., Philadelphia
Gates Rubber Co., Denver, Colo.
Hill Acme Co., Cleveland

SHEET-METAL WORKING MACHINERY (See **BRAKES, Bending Press; DIES, Sheet-Metal; FORMING Machines; NIBBLERS; PRESSES; REELS, Stripstock; RIVETERS; ROLLS, Bending; SHEARS; STITCHERS, Metal**)

SHELL-MAKING Machinery
Bullard Co., Bridgeport, Conn.
Hepburn American Co., Greenwich, Conn.
Morey Machinery Co., Inc., N. Y. C.

SHIPPING SERVICE
Railway Express, All Principal Cities

SKIDS (See **TRUCKS, Hand**)

SLEEVES & SOCKETS, Drill
Armstrong Bros. Tool Co., Chicago
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Twist Drill Co., Cleveland
Greenfield Tap & Die Corp., Greenfield, Mass.
Hardinge Brothers, Inc., Elmira, N. Y.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
National Twist Drill & Tool Co., Detroit
Pratt & Whitney Div., Niles-Bement-Pond Co., Hartford, Conn.
Scully-Jones & Co., Chicago
Standard Tool Co., Cleveland
Union Twist Drill Co., Athol, Mass.

SLOTTERS
Baker Bros., Inc., Toledo, O.
Consolidated Machine Tool Corp., Rochester, N. Y.
Douglas Machinery Co., Inc., N. Y. C.
General Machinery Corp., Hamilton, O.
Greenfield Tap & Die Corp., Greenfield, Mass.

SOCKETS, Drill (See **SLEEVES & SOCKETS, Drill**)

SOLVENTS, Oil & Grease
Detroit Rex Products Co., Detroit
Oakite Products, Inc., N. Y. C.

SPINDLES, Machine
Bryant Chucking Grinder Co., Springfield, Vt.
Dumore Co., Racine, Wis.
Ex-Cell-O Corp., Detroit
Heald Machine Co., Worcester, Mass.
Monarch Machine Tool Co., Sidney, O.
Rivett Lathe & Grinder, Inc., Boston
Scully-Jones & Co., Chicago

SPRINGS, Die
Allen Mfg. Co., Hartford, Conn.
Danly Machine Specialties, Chicago

SPROCKETS (See **GEARS, Cut**)

SQUARES, Precision (See **BLOCKS Precision Gage**)

STAMPINGS, Metal
Acromark Corp., Elizabeth, N. J.
American Brass Co., Waterbury, Conn.
Continental Machines, Inc., Minneapolis
Revere Copper & Brass Inc., N. Y. C.
Standard Pressed Steel Co., Jenkintown, Pa.
Sundstrand Mach. Tool Co., Rockford, Ill

STAMPS & HOLDERS, Steel, Safety
Acromark Corp., Elizabeth, N. J.
Cunningham Co., M. E., Pittsburgh
Moore Mfg. Co., Wm., Chicago
Noble & Westbrook Mfg. Co., East Hartford, Conn.

STAMPS, Steel (See **DIES, Marking & Embossing**)

STARTERS, Motor (See **CONTROLLERS, Motor**)

STEEL, Die
Allegheny Ludlum Steel Corp., Pittsburgh
Bethlehem Steel Co., Bethlehem, Pa.
Carpenter Steel Co., Reading, Pa.
Cleveland Twist Drill Co., Cleveland
Firth-Sterling Steel Co., McKeesport, Pa
Latrobe Electric Steel Co., Latrobe, Pa
Ryerson & Son, Inc., Jos. T., Chicago
Timken Steel & Tube, Div., Canton, O.
Vanadium Alloys Steel Co., Pittsburgh

STEEL-MILL PRODUCTS
Allegheny-Ludlum Steel Corp., Pittsburgh (Steel and stainless steel sheets, plates, tubes, wire and strip)
American Steel & Wire Co., Cleveland (Cold-finished bars, wire and wire products)
Bethlehem Steel Co., Bethlehem, Pa
Bissett Steel Co., Cleveland (Tubing)
Boker & Co., Inc., H., N. Y. C.
Carnegie-Illinois Steel Corp., Pittsburgh
Carpenter Steel Co., Reading, Pa.
Columbia Steel Co., San Francisco
Copperweld Steel Co., Glassport, Pa.
Disston & Sons, Inc., Henry, Philadelphia
Firth-Sterling Steel Co., McKeesport, Pa.
Ingersoll Steel & Disc. Div. Borg-Warner Corp., New Castle, Ind.
Jones & Laughlin Steel Corp., Pittsburgh
Latrobe Elec. Steel Co., Latrobe, Pa.
Republic Steel Corp., Cleveland
Ryerson & Son, Inc., Jos. T., Chicago
Scully Steel Products Co., N. Y. C.
Timken Steel & Tube Div., Canton, O.
Union Drawn Steel Co., Massillon, O. (Cold-finished)
Vanadium Alloys Steel Co., Pittsburgh
Wheelock, Lovejoy & Co., Inc., Cambridge, Mass.
Wyckoff Drawn Steel Co., Pittsburgh

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Carnegie-Illinois Steel Corp., Pittsburgh
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Cleveland Twist Drill Co., Cleveland
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Columbia Steel Co., San Francisco
Copperweld Steel Co., Glassport, Pa.
Firth-Sterling Steel Co., McKeesport, Pa.
Ingersoll Steel & Disc. Div. Borg-Warner Corp., New Castle, Ind.
Latrobe Elec. Steel Co., Latrobe, Pa.
Republic Steel Corp., Cleveland
Ryerson & Son, Inc., Jos. T., Chicago
Scully Steel Products Co., N. Y. C.
Timken Steel & Tube Div., Canton, O.
United States Steel Corp., Pittsburgh
Vanadium Alloys Steel Co., Pittsburgh
Wheelock, Lovejoy Co., Inc., Cambridge, Mass.

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Barrett Co., Leon J., Worcester, Mass.

STOCKS, Dies & Cutters, Pipe
Armstrong Bros. Tool Co., Chicago
Butterfield & Co., Derby Line, Vt.
Card Mfg. Co., S. W., Mansfield, Mass.
Greenfield Tap & Die Corp., Greenfield, Mass.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
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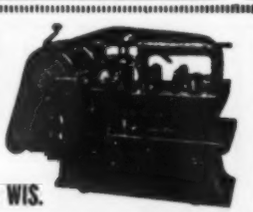

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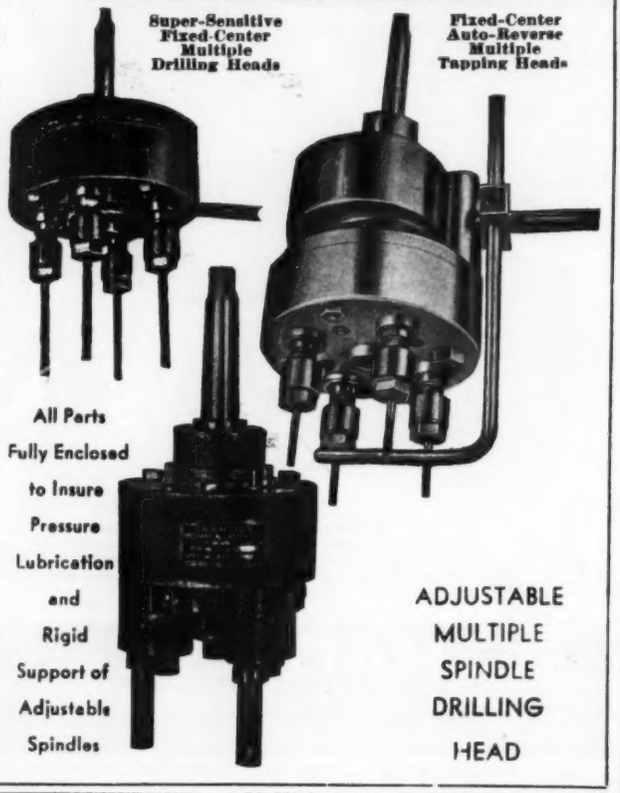
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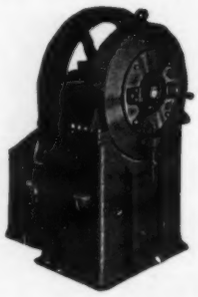

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McCaskey Register Co., Alliance, O.

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Hamilton Tool Co., Hamilton, O.

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Snyder Tool & Engrg. Co., Detroit

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Taft-Peirce Mfg. Co., Woonsocket, R. I.
Waltham Mach. Wks., Waltham, Mass.
Warner & Swasey Co., Cleveland

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Hill Acme Co., Cleveland
V. & O. Press Co., Hudson, N. Y.

THERMOMETERS, Dial
Brown Instrument Co., Philadelphia
Strong, Carlisle & Hammond Co., Cleveland

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Armstrong Bros. Tool Co., Chicago
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Hendey Machine Co., Torrington, Conn.
McCrosky Tool Corp., Meadville, Pa.
Michigan Tool Co., Detroit
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Heald Machine Co., Worcester, Mass.
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Lucas Machine Tool Co., Cleveland
McCrosky Tool Corp., Meadville, Pa.
Michigan Tool Co., Detroit
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Metal Carbides Corp., Youngstown, O.
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Scully-Jones & Co., Chicago
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Diamond Tool Co., Chicago
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Kent-Owens Machine Co., Toledo, O.
Norton Company, Worcester, Mass.
Smit & Son, J. K., N. Y. C.

TOOLS, Flexible-Shaft
Dumore Co., Racine, Wis.
Haskins Co., R. G., Chicago
Pratt & Whitney Div., Niles-Bement-Pond Co., Hartford, Conn.
Stow Mfg. Co., Binghamton, N. Y.
Strand & Co., N. A., Chicago
Walker-Turner, Inc., Plainfield, N. J.

TOOLS, Hand
Allen Mfg. Co., Hartford, Conn.
American Swiss File & Tool Co., Elizabeth, N. J.
Armstrong-Blum Mfg. Co., Chicago
Armstrong Bros. Tool Co., Chicago
Atkins & Co., F. C., Indianapolis
Automotive Maintenance Machy. Co., No. Chicago, Ill.
Brown & Sharpe Mfg. Co., Providence, R. I.
Butterfield & Co., Derby Line, Vt.
Capewell Mfg. Co., Hartford, Conn.
Carboloy Co., Detroit
Card Mfg. Co., S. W., Mansfield, Mass.
Cleveland Punch & Shear Works Co., Cleveland
Cleveland Twist Drill Co., Cleveland
Crafts Co., Arthur A., Boston
Dearborn Gage Co., Dearborn, Mich.
Disston & Sons, Inc., Henry, Philadelphia
Elastic Stop Nut Corp., Union, N. J.
Errington Mech. Lab., Stapleton, N. Y.
Gairing Tool Co., Detroit
Greene, Tweed & Co., N. Y. C.
Greenfield Tap & Die Corp., Greenfield, Mass.
Hamilton Tool Co., Hamilton, O.
Lufkin Rule Co., Saginaw, Mich.
National Twist Drill & Tool Co., Detroit
Niagara Mach. & Tool Wks., Buffalo, N. Y.
North Bros. Mfg. Co., Philadelphia
Numberall Stamp & Tool Co., Huguenot Park, N. Y.
Plomb Tool Co., Los Angeles
Pratt & Whitney Div., Niles-Bement-Pond Co., Hartford, Conn.
Producto Mach. Co., Bridgeport, Conn.
Racine Tool & Mach. Co., Racine, Wis.
Scully-Jones & Co., Chicago
Slocomb Co., J. T., Providence, R. I.
Standard Tool Co., Cleveland
Thompson & Son Co., Henry G., New Haven, Conn.
Union Twist Drill Co., Athol, Mass.
Victor Saw Works, Inc., Middletown, N. Y.
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Atlas Press Co., Kalamazoo, Mich.
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Blake Co., Edward, Newton Centre, Mass.
Bullard Co., Bridgeport, Conn.
Carboloy Co., Detroit
Cincinnati Lathe & Tool Co., Cincinnati
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Haynes Stellite Co., N. Y. C.
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Jefferson Mach. Tool Co., Cincinnati
LeBlond Mach. Tool Co., R. K., Cincinnati
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Michigan Tool Co., Detroit
National Broach & Machine Co., Detroit
National Tool Co., Cleveland
Pratt & Whitney Div., Niles-Bement-Pond Co., Hartford, Conn.
Ready Tool Co., Bridgeport, Conn.
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Starrett Co., L. S., Athol, Mass.
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Warner & Swasey Co., Cleveland
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Chicago Wheel & Mfg. Co., Chicago
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Dremel Mfg. Co., Racine, Wis.
Dumore Co., Racine, Wis.
Rotor Tool Co., Cleveland
Schauer Machine Co., Cincinnati
Skilsaw, Inc., Chicago
Walker-Turner Co., Plainfield, N. J.

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Onsrud Machine Works, Inc., Chicago
Rotor Tool Co., Cleveland
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TOOLS, Stellite
Haynes Stellite Co., N. Y. C.

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Barnes Co., W. F. & John, Rockford, Ill.
Elmes Engrg. Wks., Chas. F., Chicago
Ex-Cell-O Corp., Detroit
Sundstrand Mach. Tool Co., Rockford, Ill.

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Continental Machines, Inc., Minneapolis
Earle Gear & Machine Co., Philadelphia
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Reeves Pulley Co., Columbus, Ind.
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McCrosky Tool Corp., Meadville, Pa.
Warner & Swasey Co., Cleveland

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Kingsbury Mach. Tool Corp., Keene, N. H

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V BLOCKS (See Blocks, V)

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Littell Machine Co., F. J., Chicago
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Schrader's Son, A., Brooklyn, N. Y.
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Baldwin-Southwark Corp., Philadelphia
Barnes Co., W. F. & John, Rockford, Ill
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Elmes Engrg. Wks., Chas. F., Chicago
Nicholson & Co. W. H., Wilkes-Barre, Pa.
Racine Tool & Mach. Co., Racine, Wis.
Sundstrand Mach. Tool Co., Rockford, Ill.
Watson-Stillman Co., Roselle, N. J.

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VISES, Air-Operated
Ross Operating Valve Co., Detroit
Tomkins-Johnson Co., Jackson, Mich.

VISES, Machine
Armstrong-Blum Mfg. Co., Chicago
Armstrong Bros. Tool Co., Chicago
Atlas Press Co., Kalamazoo, Mich.
Brown & Sharpe Mfg. Co., Providence, R. I.
Chicago Wheel & Mfg. Co., Chicago
Cincinnati Milling Mach. Co., Cincinnati
Cincinnati Planer Co., Cincinnati
Cincinnati Shaper Co., Cincinnati
Covel Mfg. Co., Benton Harbor, Mich.
Desmond-Stephan Mfg. Co., Urbana, O.
Fenn Mfg. Co., Hartford, Conn.
Greenfield Tap & Die Corp., Greenfield, Mass.
Hartford Special Machinery Co., Hartford, Conn.
Hendey Machine Co., Torrington, Conn.
Jefferson Mach. Tool Co., Cincinnati
Johnson Tool Co., E. Providence, R. I.
Kearney & Trecker Corp., Milwaukee
Knight Mach. Co., W. B., St. Louis
L-W Chuck Co., Toledo, O.
North Bros. Mfg. Co., Philadelphia
Pratt & Whitney Div., Niles-Bement-Pond Co., Hartford, Conn.
Producto Mach. Co., Bridgeport, Conn.
Stevens, Inc., John B., N. Y. C.
Williams & Co., J. H., N. Y. C.

VISES, Machinists' Bench
Atlas Press Co., Kalamazoo, Mich.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Mach. Co., Cincinnati
Desmond-Stephan Mfg. Co., Urbana, O.
Fenn Mfg. Co., Hartford, Conn.
Fray Machine Tool Co., Glendale, Calif.
Jefferson Mach. Tool Co., Cincinnati
New Britain-Gridley Machine Co., New Britain, Conn. (Stands)
North Bros. Mfg. Co., Philadelphia
Wiedemann Machine Co., Philadelphia

VISES, Pipe
Armstrong Bros. Tool Co., Chicago
Desmond-Stephan Mfg. Co., Urbana, O.
Greenfield Tap & Die Corp., Greenfield, Mass.
Williams & Co., J. H., N. Y. C.

WASHING & DRYING, Machines (See METAL-CLEANING EQUIPMENT)

WELDERS, Arc
Air Reduction, N. Y. C.
Allis-Chalmers Mfg. Co., Milwaukee
General Electric Co., Schenectady, N. Y.
Harnischfeger Corp., Milwaukee
Hobart Bros. Co., Troy, O.
Lincoln Electric Co., Cleveland
Westinghouse Elec. & Mfg. Co., E. Pittsburgh, Pa.

WELDERS, Resistance
Ohio Machine Tool Co., Kenton, O.

WELDERS, Spot
Ohio Machine Tool Co., Kenton, O.
Progressive Welder Co., Detroit

WELDING ACCESSORIES
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Cullen-Friestedt Co., Chicago
Lincoln Electric Co., Cleveland
Mallory & Co., Inc., P. R., Indianapolis (Electrode Holders)

WELDING CONTROLS
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Lincoln Electric Co., Cleveland

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General Electric Co., Schenectady, N. Y.

WELDING POSITIONERS
Cullen-Friestedt Co., Chicago

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Aluminum Co. of America, Pittsburgh
American Brass Co., Waterbury, Conn.
American Steel & Wire Co., Cleveland
Atkins & Co., E. C., Indianapolis
Harnischfeger Corp., Milwaukee
Haynes Stellite Co., N. Y. C.
Hobart Bros. Co., Troy, O.
Lincoln Electric Co., Cleveland
McKay Co., Pittsburgh
Page Steel & Wire Div., Am. Chain & Cable Co., Monessen, Pa.
Revere Copper & Brass Corp., N. Y. C.
Roebling's Sons Co., John A., Trenton N. J.
Ryerson & Son, Inc., Jos. T., Chicago
Westinghouse Elec. & Mfg. Co., E. Pittsburgh, Pa.

WELDING TIMERS
Lincoln Electric Co., Cleveland

WELDING TIPS
Mallory & Co., Inc., P. R., Indianapolis

WHEELS, Grinding & Polishing
Bakelite Corp., N. Y. C.
Bay State Abrasive Products Co., Westboro, Mass.
Blanchard Mach. Co., Cambridge, Mass.
Bridgeport Safety Emery Wheel Co., Bridgeport, Conn.
Carborundum Co., Niagara Falls, N. Y.
Chicago Wheel & Mfg. Co., Chicago
Cincinnati Milling Mach. Co., Cincinnati
deSanno & Son, Inc., A. P., Phoenixville, Pa.
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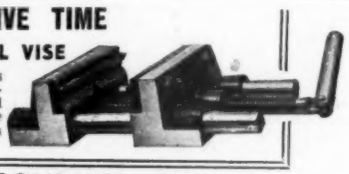

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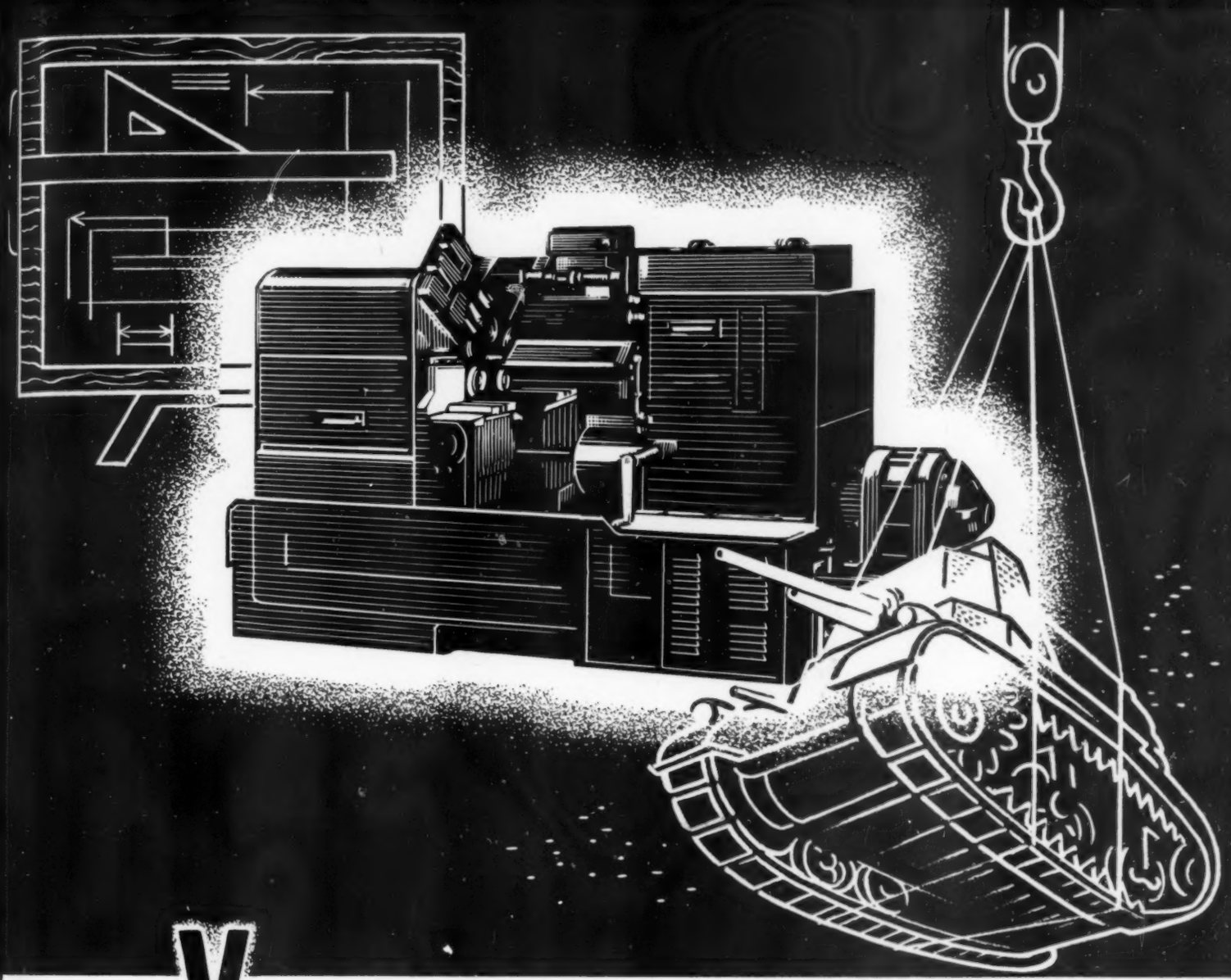

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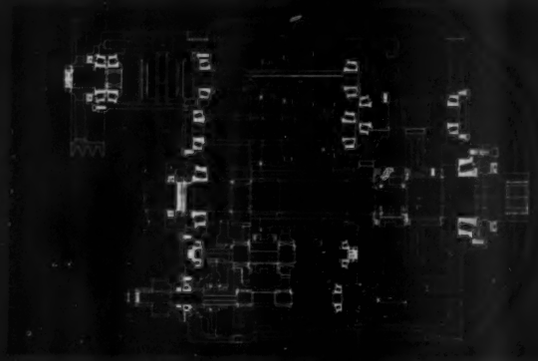

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